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Observations on the Etiology and Frequency of Spondylolisthesis and Its Precursors[1]

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IN LESS THAN twenty years the concept of spondylolisthesis has changed so that its occurrence is now considered fairly frequent, rather than being looked upon as a rarity. Furthermore, there is now general agreement that the term "spondylolisthesis" should be limited to those cases in which forward displacement of the vertebral body has occurred accompanied by bone defects consisting of a solution of continuity in the isthmi, or partes interarticulares, of the involved vertebrae. When such defects are present without accompanying ventral displacement of the vertebral body, the term "prespondylolisthesis," "spondylolysis," "spondyloschisis" or, perhaps most logically, as suggested by Lerner and Gazin (14), "interarticular isthmus hiatus," is used.

The studies to be reported here have been limited to developing further information on the following subjects:

1. The genesis and frequency of vertebral isthmus defects with a discussion as to whether such defects are congenital or traumatic in origin. Cases of hereditary transmission are presented.

2. The frequency of occurrence of spondylolisthesis and its precursors. Some 2,080 unselected young men—candidates for the Armed Forces—were given routine lateral x-ray examinations of the lumbosacral spine to obtain this information.

3. An analysis of these cases to determine how many individuals with such defects actually have low-back pain.

4. Useful clinical signs by means of which spondylolisthesis or its precursors can frequently be detected.

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Just as trauma is considered a cause of bone defects in other regions of the body, so it has been indicated as responsible for spondylolysis and spondylolisthesis. A consideration of the possible influence of trauma should be divided into two parts.

1. Is the interarticular isthmus hiatus of spondylolysis itself traumatic in origin?

2. When actual forward slipping has occurred, so that by definition true spondylolisthesis is present, has the separation of the defect been occasioned by trauma, or will trauma be likely to produce symptoms in patients who already have such defects?

Whether the defect in the vertebral isthmus is traumatic or congenital in origin has been the subject of considerable debate. Contrary to some of the older concepts in this country, there is now a general agreement by the proponents of

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Fig. 1. Case I (Daughter): Moderate spondylolisthesis with typical isthmus defect. No symptoms.

the traumatic theory of etiology that such trauma must have occurred very early in life. Hitchcock (12) calls attention to the likelihood of hyperflexion during the birth process as a cause. By hyperflexion of the spine, often of moderate degree and with little force, he has been able readily to fracture the neural arch in the lower lumbar region in fetuses and stillborn children.

It may seem strange, in the face of evidence to be later considered, that some conscientious investigators who have made numerous thorough examinations of fetuses and stillborn children still give credence to the traumatic theory of origin. The reason for their belief lies in the fact that no one has ever been able to find a failure of development in the neural arch, not subject to objection, in the material examined. Since the incidence of the defect is about 5 per cent, as will be explained later, it might be expected that in several hundred examinations of fetuses and stillborn children the condition would be found at least once. However, except for Batts (3), who described an accessory center of ossification in the neural arch of the third lumbar vertebra of a fetal spine, no other authors have given authentic descriptions of such an accessory center.

On the contrary, a single center of ossification appears early in each neural arch. It is true that this ossification center is formed in the region which later becomes the pars interarticularis and that this region is a zone of potential weakness because of the presence of slow ossification and numerous nutrient blood vessels (Willis, 19, 20).

The development of two centers of ossification for the neural arch, though not well proved, continues to be as attractive as Willis (19) believed it in 1931, for such a hypothesis—even though it may not be established to the satisfaction of all investigators—would adequately explain later appearances on the basis of failure of fusion of such anomalous centers. Failure of fusion of other ossification centers of the vertebrae, both of primary and secondary types, is common enough (Bailey, 1, 2).

In summary, therefore, it must be admitted that the evidence in favor of the traumatic theory is based upon the idea that fractures in this region can be produced experimentally in the newborn (Hitchcock, 12), and upon the purely negative finding that neural arch defects of the type which would be expected to develop into spondylolisthesis have not been discovered in fetal and newborn material in several hundred examinations, with a possible single exception (Batts, 3).

On the contrary, when the genesis of such defects is considered to be congenital, the amount of favorable evidence becomes enormous.

1. These defects may involve more than one segment. Friberg (7) reports very clear-cut involvement of all segments from the twelfth thoracic to the fourth lumbar, inclusive, and numerous cases in which two segments have been involved are reported (5, 15, 19).

2. There is general agreement that about 25 per cent of these defects are uni-

Fig. 2. Case II (Father): Moderately advanced spondylolisthesis with typical isthmus defect. Absence of intervertebral disk; reactive bone changes in adjacent vertebral bodies.

Fig. 3. Case III (Grandmother): Isthmi of fifth lumbar vertebra very thin but apparently continuous. Lumbosacral intervertebral disk space almost absent, with reactive hypertrophic bone fringes.

lateral. We are inclined to agree with Garland (8), however, that closer inspection with oblique views reveals only about 5 per cent of unilaterality. In any event, the occurrence of unilaterality favors the developmental theory of origin.

3. The frequency in various widely different races is nearly the same. In 1,520 skeletons examined (Willis, 19), the incidence was 5.2 per cent. Shore (17) reported an incidence of 6.09 per cent in 82 skeletons of Bantu natives in South Africa. Congdon (6) discovered an incidence of 5 per cent in the skeletons of 200 American aborigines. In summary, these series, widely scattered in both time and space, showed neural arch defects in 5.2 per cent of 1,802 individuals.

4. Numerous cases of spondylolisthesis or spondylolysis have been reported in children in recent years. Kleinberg (13) recorded a case of well defined spondylolisthesis in a child of nineteen months. Since this child had never walked because of other developmental anomalies (bilateral congenital hip dislocation), it was self-evident that trauma could not have been a factor.

5. While it is true that normally a separate single ossification center is usually present for the lateral vertebral arch, it is entirely possible that on occasion two bone nuclei are laid down in this region, with subsequent failure of fusion. Similar examples, such as bipartite patellae, occur elsewhere in the body.

6. Heredity plays a definite role. In this study, three cases of hereditary transmission are added to the one case already described in the American literature, by George (9).

CASE I. R. M. B. (the daughter), student, age 18. Despite typical isthmus defects and actual mild spondylolisthesis, this young woman has no complaints, the lesion having been an incidental finding. The patient's hobby is horseback riding, which causes no low back pain (Fig. 1).

CASE II. M. J. B. (the father), orthopedic appliance manufacturer, age 45. Two years before

spondylolisthesis was discovered, the patient fell from a horse, landing on his buttocks. No x-ray studies were made at that time. Symptoms of back pain persisted for only two days. Spondylolisthesis was an incidental discovery two years later. For years since, this man has ridden spirited horses without provoking low back pain. This case illustrates that moderately advanced spondylolisthesis is not necessarily disabling (Fig. 2).

CASE III: S. B. (the grandmother), orthopedic appliance fitter, age 66. This patient has not had any complaints of low back pain except for a period of several weeks twenty-five years ago. Despite the absence of the lumbosacral disk and resultant localized hypertrophic changes, frequent horseback riding has never provoked symptoms (Fig. 3).

In the European literature four families have been mentioned (Glorieux and Roederer, 10), by various authors, in which spondylolisthesis or spondylolysis was found in parents and their children. It remained for Sten Friberg (7) to make a monumental report covering three generations of a family consisting of 65 individuals. Sixty-one of these 65 relatives were examined, starting with a spondylolisthetic grandfather. Of this number, 15 showed spondylolytic changes.

An interesting sidelight in this series was that of the 16 patients seen (including a spondylolisthetic man who married into the family), all were engaged in heavy manual labor; yet only 3 had any symptoms of low back pain.

OCCURRENCE WITHOUT SYMPTOMS

Because of this frequent occurrence of spondylolisthesis or spondylolysis without symptoms, it was proposed to carry the investigation further by examining a large group of supposedly normal persons—mostly candidates for the Armed Forces and selected without reference to history or symptoms. Lateral lumbosacral roentgenograms were taken on 2,080 individuals. In this series 4.4 per cent were found to show spondylolisthesis or spondylolysis, but only 0.5 per cent complained of any previous or present low back pain.

Early in the series it became apparent that attempts to separate those who had actual forward slipping of the vertebra from those who merely had spondylolysis defects would not yield entirely accurate results, for special lateral x-ray examinations made in maximum extension and maximum flexion, or in the supine and later the erect position, showed in about 48 per cent of the cases at least a few millimeters of forward movement of the involved vertebral body. The following case is typical.

CASE IV: W. S., an 18-year-old college youth, son of a radiologist, had never had symptoms of low back pain despite rather strenuous programs of athletics. His sole physical finding was prominence of the spinous process of the fifth lumbar vertebra. X-ray examination revealed a well-marked lysis of the vertebral isthmi. A lateral film made in flexion showed 9.0 mm. of forward displacement of the fifth lumbar vertebral body (Fig. 4), while a film made in extension showed only 7.0 mm. of forward displacement of the same vertebral body (Fig. 5.)

A USEFUL CLINICAL SIGN

Persons with advanced spondylolisthesis may show a typical clinical sign (Fig. 6). There is an offset of the spine which can be distinguished by a dimple or groove above the involved vertebra. There is also an undue prominence of the spinous process of the involved vertebra. Such signs are to be expected in advanced cases. Indeed, in the presence of lysis of the neural arch there is no reason why the posterior half of the vertebra should not migrate somewhat dorsally at the same time the vertebral body is migrating ventrally.

From the standpoint of logic alone, however, when only a simple lysis is present, prominence of the involved vertebral spinous process with a concavity above it might not be expected. Hall (11), working with some of the same material used in this study, noted, however, that simple lysis could often be detected in ordinary physical examinations by three signs.

1. An undue amount of flexion of the spine was detectable.

2. With full flexion, an unduly prominent lumbar spinous process (usually the fifth) might be detected, which would be tender to palpation.

Figs. 4 and 5. Case IV. Fig. 4 is a lateral film *in flexion*, showing *9 mm.* forward displacement of the fifth lumbar vertebral body. A depression in the cranial surface of the sacrum indicates that forward displacement, though symptomless, is of long standing. Fig. 5, a lateral film made *in extension*, shows *7 mm.* of forward displacement of the fifth lumbar vertebral body.

3. Such a spinous process might be more mobile than normal.

In an effort to refer for x-ray studies only those individuals in whom a neural arch defect was present, the above clinical signs were used in 2,080 cases. As a result, the number of cases in which positive findings were present rose from the usual 4.4 per cent on unselected material to between 29 and 50 per cent, depending upon the experience of the clinician. The signs are simple and seem well worth using, therefore, when large groups are being examined.

COMMENT

Since an average of one individual in twenty shows isthmus defects in careful x-ray examinations, and, in many, actual forward motion of the vertebral body can be demonstrated by special technics, the question arises whether such men can be useful for vigorous physical effort such as military service or heavy manual labor. Hitchcock (12) has followed four cases of spondylolisthesis in which progressive increase in forward slipping over a period of years has been demonstrable.

As already noted, congenital isthmus defects are frequently present without the patient being aware of them. The trend is recently more and more to regard such defects as being in the same category as fully sacralized fifth lumbar vertebrae, lumbar ribs, spina bifida occulta, etc. As Bohart (4) pointed out, such developmental anomalies did not prove a source of symptoms in a large series of men he examined, who were frequently subjected to severe trauma.

We should probably not be too ready to indict isthmus defects as a cause of symptoms. It is undoubtedly true that patients with spondylolysis and spondylolisthesis sometimes have low back pain. So do others. Meyerding (16) suggests intervertebral disk displacement rather

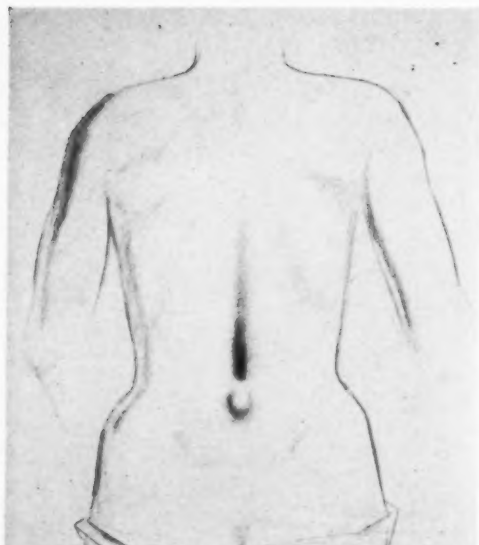

Fig. 6. A characteristic dimple or groove is often present above the spondylolisthetic vertebra. The spinous process of the involved vertebra is sometimes unusually prominent.

than the movement of the vertebral body as a cause of this pain. Whatever the cause actually may be, it is well to bear in mind that many individuals with well advanced lesions are symptom-free or nearly so. The family previously discussed as showing hereditary transmission (Figs. 1–3) was typical, in that the patients, in spite of moderately advanced lesions, had little or no back pain.

SUMMARY

1. About 5 per cent of people of all races show vertebral isthmus defects. Accumulated evidence seems definitely to indicate that such defects are congenital in origin.

2. Hereditary transmission occurs, as is shown by cases presented here.

3. Among 2,080 lateral lumbosacral x-ray examinations made on unselected cases, 4.4 per cent showed isthmus defects. Only 0.5 per cent of these individuals had complained of low back pain. It is, therefore, often incorrect to conclude that spondylolisthesis or its precursors is in any way connected with trauma.

4. When special x-ray studies were made with the patient erect and recumbent, or with full flexion and extension, some forward motion of the vertebral body could be demonstrated in 48 per cent of those having isthmus defects.

5. Several simple clinical signs are described, by means of which persons most likely to show defects can be selected for x-ray examination.

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Roentgen Features of Mucocele of the Appendix[1]

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ALTHOUGH MORE than five hundred cases of cystic dilatation of the appendix have been recorded in the literature (19), little has appeared concerning the diagnostic aspects of the condition. Since the original description by Rokitansky (18) in 1842, a fairly complete knowledge of the surgical and pathological features has been gathered. At the Mayo Clinic, 146 cysts were found among 43,000 appendectomies, an incidence of one in three hundred (22). It is generally accepted that the primary etiologic factor is obstruction of the lumen of the appendix, in the absence of pyogenic infection (2). Naeslund (12), in 1928, produced typical mucoceles in rabbits by simple ligature of the vermiform processes.

Clinically, the lesion varies in size from a slight localized enlargement of the appendix to a globular mass 10 cm. or more in diameter (13). It is usually benign but, in the event of rupture into the peritoneal cavity, pseudomyxoma peritonei may result. Woodruff and McDonald (22), however, present evidence to support the belief that this malignant complication can arise only when the cyst is the seat of an adenocarcinoma, none of 8 benign cysts encountered with rupture having eventuated in this fashion. But, since there are no means of distinguishing the malignant from the benign forms of the disease, except by histologic study, any diagnostic method which will increase the frequency of its preoperative recognition is of more than academic importance.

Anatomically, there are certain features of the disease which should render it susceptible of roentgen diagnosis in many instances. When the cyst attains sufficient size, it will produce significant displacement and deformity of the cecum, to which it is attached. For the same reason, if the cecum is mobile, and it usually is, the mass will move with it. Calcific deposits in the wall or substance of the cyst are of not infrequent occurrence (2, 14, 15). The closed nature of the cyst makes its lumen impermeable to contrast media administered orally or by enema, unless patency is re-established. The latter situation is known to occur, cases recognized roentgenoscopically having been reported by Vorhaus (21) in 1930 and by Lifvendahl and Ries (10) in 1932. But the frequency of such an occurrence must be insignificant; Woodruff and McDonald (22) did not report a single instance in a series of 146 cysts.

In spite of these distinctive features, most writers have been pessimistic with regard to the likelihood of a preoperative diagnosis of appendiceal mucocele (3, 4, 6, 9). Jackson (7), however, in 1936, expressed the opinion that more careful x-ray studies might prove of value in the future recognition of the condition. In the same year, Åkerlund (1) demonstrated a correlation between the roentgen and pathological findings in two cases in which the roentgenograms had been inadequately interpreted preoperatively. He pointed out that a roentgen diagnosis of this affection is possible where, "in the absence of contrast filling of the appendix, one finds a rounded, sharply outlined soft-tissue shadow in the cecal region, without any connection with adjacent parenchymatous organs, and where, within this soft-tissue shadow, one can demonstrate superficial calcium deposits which give the picture an appearance somewhat similar to the findings in cholecystitis calcificans." Jutras (8), in 1938, furnished further support to Åkerlund's opinion in a case of his own, as well as in two cases which had previously been published by a colleague (11). In July 1939, Goinard *et al.*

[1] Accepted for publication in March 1945.

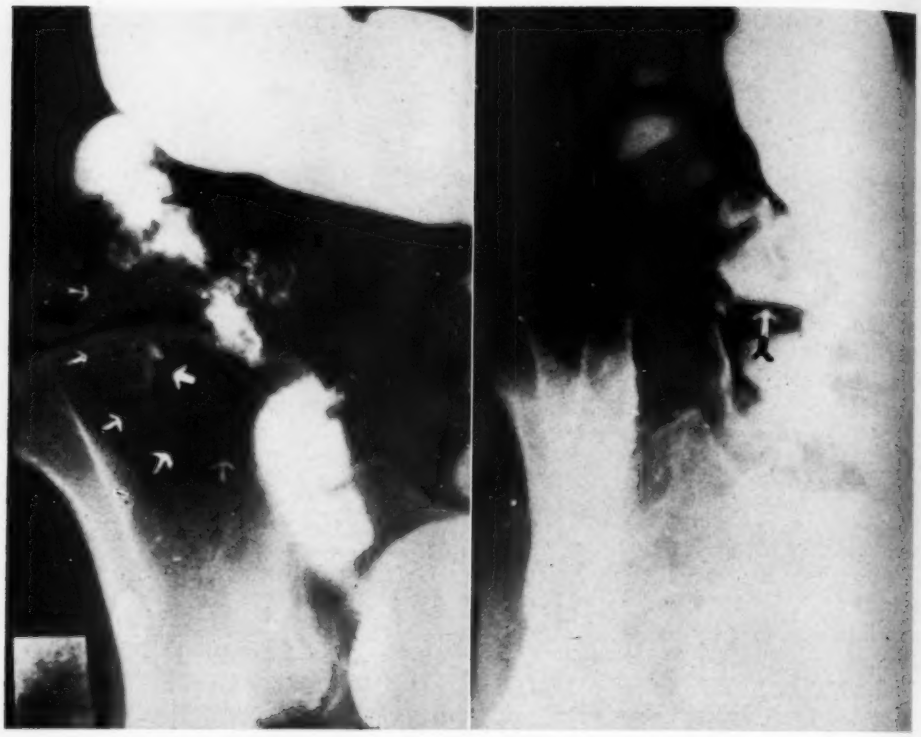

Fig. 1. Barium enema study, postero-anterior projection, showing soft-tissue mass with calcific central deposit, adjacent to cecum.

Fig. 2. Right anterior oblique projection, showing anteromedial displacement of cecum.

(5), apparently unaware of previous radiological publications, presented a case with characteristic roentgen features, in which the preoperative diagnosis was "benign mass." In October of the same year, Varela-Fuentes *et al.* (20), of Montevideo, reported the first instance of a correct preoperative diagnosis based on Åkerlund's description. Another instance is presented herewith.

CASE REPORT

Mrs. E. B., a white woman, aged 42, was admitted to the hospital complaining of a dull ache in the right lower quadrant of the abdomen, of ten months' duration, present only when she lay supine. Her past history was negative in the sense that she had never had any serious illness or symptoms referable to this area. However, she had been troubled by constipation and heartburn during her entire adult life. About seven years prior to admission, a radiological examination of the gastrointestinal tract had been done at a large metropolitan clinic, but no organic disease was disclosed at that time. Menses were regular and normal. The patient had had two children, delivered spontaneously, without complications. The gynecological history was negative.

The onset of the present illness occurred insidiously, about ten months earlier, when the patient noticed a dull pain in the right lower abdomen upon lying down. The pain disappeared when any position other than supine was assumed. Occasionally, it radiated down the right leg to the knee. There were no other associated symptoms, no nausea or vomiting, no diarrhea or inordinate constipation, nor was blood or mucus present in the stools. The urine was negative. The symptoms remained essentially unchanged for ten months, when, upon the advice of her family physician, the patient was hospitalized with a view to appendectomy.

On physical examination, positive findings were limited to the right lower quadrant of the abdomen. Here, a smooth, round, moderately tender mass, mobile in all directions, was palpable at the level of the anterior superior spine of the ilium. There was

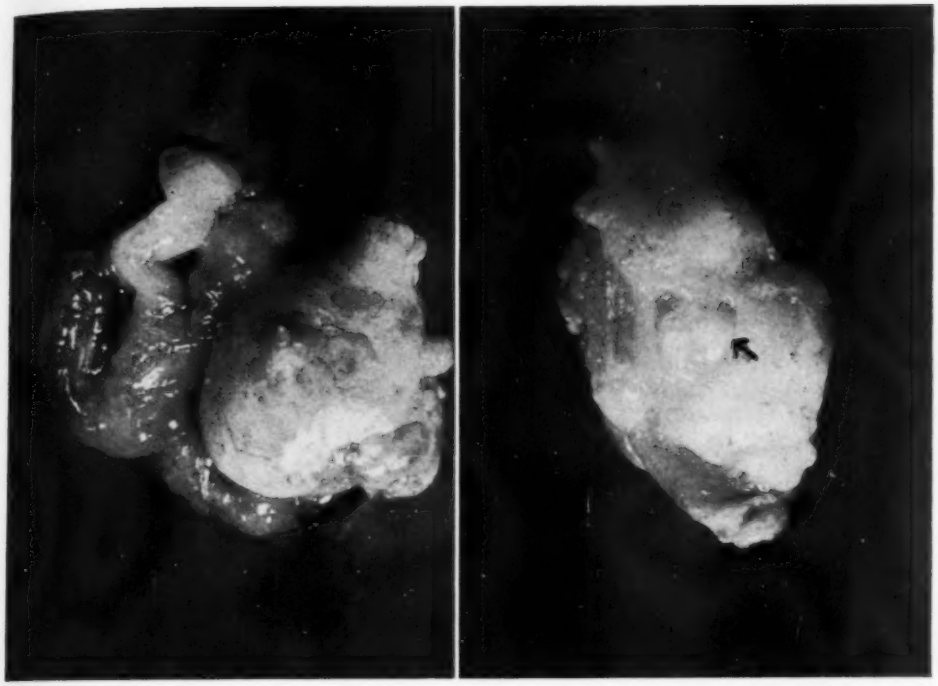

Fig. 3. Photograph of gross specimen with some of gelatinous content which leaked out during manipulation.
Fig. 4. Cross section of gross specimen, showing central calcific deposit.

no muscle spasm or rebound tenderness in this region. No other abdominal mass or viscus was palpated. There was no costovertebral tenderness. Rectovaginal examination revealed no mass within reach of the examining finger. Examination of the blood and urine disclosed no evidence of anemia, leukocytosis, hematuria, or pyuria.

The patient was referred to the radiologist with a tentative diagnosis of mucocele of the appendix or right ovarian cyst with a long pedicle. A barium enema study (Figs. 1 and 2) revealed no abnormality of the colon between the rectum and cecocolic junction. Passage of the clysma elicited no pain or discomfort. There was moderate delay in filling of the cecum, which was displaced medially and anteriorly by a reniform, freely mobile, sharply circumscribed soft-tissue mass, measuring about 6 × 10 cm. The lateral and posterior margins of the cecum, as well as the adjacent descending colon and terminal ileum, were grossly concave where the mass came in contact with them. Upon manual displacement, the mass maintained its relationship to the cecum, but the descending colon and ileum could be separated from it. The mucosa of the colon and ileum appeared to be intact. In the center of the mass was an irregular accumulation of material of calcific density, resembling a swastika in configuration. No stratified calcification could be distinguished. The contrast agent did not enter the lumen of the appendix. Radiographic study confirmed these findings, except that, due to spasm of the cecum, the concave deformity was not demonstrated. A radiological diagnosis of mucocele was made.

At operation, a retrocecal cystic mass, identified as a mucocele of the appendix, was found. The right ovary was cystic, but otherwise normal in appearance. Both the appendix and ovary were resected. During manipulation, the mucocele was ruptured, a small amount of blood-tinged gelatinous fluid escaping into the free peritoneal cavity.

Pathologic examination revealed (1) a mucocele of the appendix, measuring 8.0 cm. in diameter, with a dense, calcified mass in its center, and (2) a pseudomucinous cyst of the ovary, 5.0 cm. in diameter (Figs. 3 and 4). Chemical examination proved the content of both tumors to be pseudomucin. In order to establish the calcareous nature of the deposit, and to rule out the possibility of inspissated barium, qualitative analysis was made. This resulted in strongly positive tests for calcium, with no trace of barium.

The patient made an uneventful recovery.

DISCUSSION

A review of the literature reveals but three published cases (10, 20, 21) of muco-

cele of the appendix in which a correct diagnosis was made prior to operation or autopsy. A fourth case is described here. As early as 1915, Ogilvie (16) reported an instance of calcareous mass in the right lower quadrant of the abdomen, in which "the roentgenogram clouded the picture," the diagnosis hinging between a ureteral calculus and a calcified cyst of the appendix. Undoubtedly, had more modern methods of urological diagnosis been available to him, a correct diagnosis would have been made. Timoney (19) states that LeWald made a correct diagnosis on the basis of roentgen findings many years ago, but he does not describe them. Scrutiny of published reproductions of roentgenograms, especially those of Jutras (8), Mousseau (11), Goinard *et al.* (5) Varela-Fuentes *et al.* (20), and of Ostrum and Miller (17), lead to the conclusion that Åkerlund is correct in his assumption that a roentgen diagnosis of mucocele should be feasible in many instances.

Unquestionably, the diagnosis has usually been missed because it has not been considered. A more recent failure (17) may be attributed to lack of familiarity with the literature on the subject, for the authors in this instance fail to mention the papers of Åkerlund and Jutras, and express the unfounded belief that their case was "unique . . . the first case of calcified mucocele of the appendix reported."

It is felt that while all of the criteria enumerated by Åkerlund are of value in the diagnosis of this condition, not all are essential. A sharply circumscribed globular or kidney-shaped mass, mobile but not separable from the cecum, with displacement of the latter in a medial direction, can hardly be attributed to anything other than mucocele. Additional findings, such as failure of the appendix to fill with a contrast agent, calcification, and a vortical appearance of the cecal mucosal pattern, as described both by Vorhaus (21) and Jutras (8), simply add further support to the diagnosis. A pyogenic abscess of the appendix or peri-appendicular tissues is a firmly fixed mass. An ovarian cyst not only is unlikely to become adherent to the cecum but, if it does, will displace it laterally rather than medially. A retroperitoneal tumor should be fairly immobile. An intrinsic tumor of the cecum does not displace it. Calculi of urinary origin are identified by urological methods.

SUMMARY

1. Little has been published concerning the diagnosis of mucocele of the appendix. Since the appearance of Åkerlund's study (1), fairly definite roentgen criteria for accurate diagnosis have been established:

(*a*) A sharply circumscribed, globular or reniform soft-tissue mass, with considerable mobility, but firmly attached to the cecum.

(*b*) Medial displacement of the cecum by this mass.

(*c*) Calcium deposits in the wall or substance of the mass, failure of the appendix to fill with contrast agent, and a vortical appearance of the folds of cecal mucosa support, but are not essential to the diagnosis.

2. A case in which a correct preoperative diagnosis was made, chiefly on the basis of Åkerlund's criteria, is reported.

3. Attention is invited to the importance of considering the likelihood of this disease when clinical or roentgen findings point to the right lower quadrant of the abdomen.

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Roentgen Treatment of Infections of the Tonsils and Post-Pharyngeal Lymphoid Tissues in Children[1]

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THE PURPOSE OF this paper is to stress the value of roentgen therapy in the treatment of infections of the tonsils and the post-pharyngeal tissues in children. The lack of material in the literature on this method of treatment indicates a failure to realize its importance.

No attempt is being made to compare results obtainable by roentgen therapy with those obtainable by other methods. Neither is it our object to show the superiority of irradiation to surgery, or *vice versa*. Any statement made concerning a patient "without tonsils or adenoids" is made with the intention of indicating that they have been removed surgically. No reflection upon surgery is intended. Tonsillar and adenoid tissue may still be present, not because of the failure of complete removal, but because of persistent infection, causing regeneration of lymphoid tissue. Crowe writes: "Adenoids recur in more than 75 per cent of the children whose tonsils and adenoids have been removed before the age of puberty. It is so common that it must be regarded as normal."

In no instance was roentgen therapy administered with the view of eradicating tonsillar or adenoid tissue. Where tonsils appeared to be reduced in size, it was felt that the reduction was due to relief of infection in the tonsil and adjacent tissues. Although many cases of apparent primary tonsillitis were seen and treated, most cases appeared to be secondary to post-pharyngeal disease.

A statistical study based on the total number of cases treated has not been made because of inability to obtain complete returns to a questionnaire. Results have been determined by questioning parents directly, when possible, and by expressions of satisfaction on the part of referring physicians. Confidence of physicians in the method is indicated by the fact that they have continued to refer patients, in increasing numbers. In most instances, responses to other forms of therapy, both medical and surgical, had been unsatisfactory, and the attending physician referred the patients for roentgen therapy. In some cases, children were referred on insistence by the parents. The number of referring physicians, including pediatricians, is indicative of the part this form of therapy is playing in our community.

INDICATIONS

Roentgen therapy to the pharyngeal tissues was first used only in cases in which tonsils and adenoids had been removed surgically. The symptoms which had led to operation either persisted or recurred after a short period of relief. These symptoms included recurrent or persistent colds, with or without cough; varying degrees of colored nasal and post-nasal drainage; recurrent sore throat, usually preceded by a cold. In some instances discharge from the ears, decreased acuity of hearing, or even deafness was noted. Examination of the nose and throat showed evidence of chronic infection. There was swelling of the membrane of the nasal cavity, with mucopurulent or purulent discharge. The pharynx usually contained granulation tissue or what appeared to be hypertrophied tissue, probably lymphoid. Injection and redness of the pharynx and tonsillar pillars were the rule. Either the tonsils were absent or some tonsillar tissue was present, due to recurrence or incomplete removal. Con-

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siderable mucopurulent post-nasal discharge was evident. When roentgen therapy was administered to the nasopharynx and cervical regions of these patients, the response was remarkable and the symptoms disappeared rapidly.

Because of the satisfactory response to irradiation in cases previously treated surgically, children with similar symptoms, who had not been subjected to tonsillectomy and adenoidectomy, were also given roentgen therapy. The results proved equally satisfactory and even more spectacular because this was the sole method of treatment. Now the number of patients referred for treatment with tonsils and adenoids still present exceeds the number without tonsils and adenoids, 10 to 1.

In almost all patients, there is a history of recurrent or persistent colds. The chief complaint, however, may differ. Because the chief complaint is so definite, we have classified the cases into seven groups on that basis: (1) cough; (2) tonsillitis and sore throat with or without cervical adenitis; (3) gagging and vomiting; (4) mouth breathing, with nasal obstruction; (5) ear disturbance—recurrent or persistent draining ears with or without hearing difficulty; (6) asthma; (7) any combination of the above. No distinction is made in these groups as to whether tonsils and adenoids are present or absent. The symptoms are not necessarily attributable to their presence *per se*.

Of the patients in whom cough was predominant, many had had the tonsils and adenoids removed with the assurance that the cough would disappear. In most cases the cough diminished or disappeared entirely after one x-ray treatment. In a few instances cough was increased after the first treatment only to improve or disappear after the second treatment. This is not easily explained except to say that increased nasal and post-nasal drainage was noted after the first treatment and may have prompted an increase in the cough. In only a few cases did cough persist after three treatments. In those instances, it entirely abated as a chief complaint by the end of the treatment series. The presence or absence of tonsils did not affect the result.

The relief of cough is probably due to a decrease in the swelling of the pharyngeal tissues together with an ultimate decrease in the drainage, which must be a factor in inciting the cough reflex. This does not fully explain the response, however, since in many instances post-nasal drainage is not present when the patient is first seen. Relief of cough may be explained on another basis, namely, a chemical change in the nasal secretion or drainage. This is merely a conjecture but should be considered in further studies. A similar relief of cough has been observed in adults in whom sinusitis existed with pharnygeal granulations, injection, and post-nasal drainage. Here, chest therapy is most essential and higher dosages are given because a bronchitis is invariably present. If irradiation were used only for the intractable cough due to upper respiratory infection, the method could be said to hold a respected place in the field of therapy.

In the group complaining chiefly of recurrent tonsillitis and sore throat, with or without cervical adenitis, the response is only second to that shown in the cough group. Here again the presence or absence of tonsils and adenoids does not change the results.

Because the tonsillitis and sore throat were preceded by colds, either recurrent or persistent, it is felt that in most instances the tonsillitis is to be regarded as a secondary manifestation. Relief of the pharyngeal and nasal condition produces relief of the tonsillitis and the throat symptoms. Similarly, in adults, where tonsils have been removed, treatment of the sinuses and pharyngeal area has a favorable effect. Pain and soreness in tags in the tonsillar floor are always relieved, thus making unnecessary further surgical removal.

In the group in which gagging and vomiting prevail, the pharynx is swollen and red. Consequently the pharyngeal space

shows a marked reduction in size. Gagging and vomiting are probably a reflex manifestation, due to a partially obstructed passageway.

Mouth breathing and nasal obstruction are disturbing but usually of not too great significance. In very young children and infants, however, irradiation has been most successful in bringing about rapid amelioration of such symptoms, forestalling surgical removal of adenoid tissue. Our records show numerous cases that were treated three to six years ago with no recurrence of the obstructive symptoms. Here again, it is felt that the obstruction was due to infection, with swelling of the adenoids and edema of the pharyngeal tissues, rather than to a true adenoid hypertrophy. The roentgen dosage was insufficient to produce atrophy of the adenoid tissue. Furthermore, too many patients with persistent mouth breathing and nasal obstruction were seen soon after adenoidectomy to make us feel that enlarged adenoids are the main cause of the obstruction. In these cases, also, x-ray therapy produced the desired results promptly.

Nearly all the patients with ear symptoms treated with irradiation had been subjected to tonsillectomy and adenoidectomy. As pointed out above, however, the recurrence of adenoids after surgery is so frequent (75 per cent of cases) that it may be regarded as normal. This recurrent lymphoid tissue may maintain infection or become re-infected, impair the function of the eustachian tube, and produce a low-grade tubotympanic infection leading to a chronic progressive deafness. These hyperplastic infected adenoid nodules are located in and around the eustachian tube and are not amenable to surgical removal. Infected lymphoid tissue is so sensitive to irradiation that only a small dose is needed, far below the amount that could cause any irradiation injury to the mucous membrane or surrounding structures. In resistant cases we have found that increasing the dose to 125 r through the lateral nasopharyngeal port, with a lead screen 6 × 6 cm., is usually successful without resort to the use of radium in the nasopharyngeal area. Irradiation is repeated every two or three days for four treatments. Treatment should be instituted before permanent changes occur.

Roentgen therapy has no place in chronic middle ear suppuration, otosclerosis, or any form of inner ear or nerve deafness. Its purpose is to restore the normal air-passage function of the eustachian tube by cleaning up the infected swollen lymphoid tissue around the stoma.

In asthma due solely to allergy, roentgen therapy has no place. There is no question, however, as to its advantage when the cause is an upper respiratory infection with tracheobronchitis and hilar adenitis, or where an allergy and infection are combined, with the infection predominant. In the former case, the asthma usually disappears and recurs only with reinfection. In this instance asthma manifests itself not as a result of a single cold or infection of the upper respiratory area but after repeated colds. Consequently, the patient becomes sensitive to his own infection, and asthma ensues. A repetition of roentgen therapy shows the same good results as the primary series. Where combined allergy and infection of the upper respiratory tract exist, the infection probably lowers the child's resistance and makes him much more sensitive to his allergins. Roentgen therapy has its effect on the infection, thereby producing a decrease in the number and severity of the asthmatic attacks. This is indicated by a longer period of well being with less need for medication.

It has been interesting to note that most of the children we have treated had an accompanying loss of appetite, with failure to gain or maintain weight. Lethargy, loss of energy, and fatigue were also present. The loss of appetite is due either to toxicity from the infected lymphoid tissue or to mechanical difficulty (edematous tissue), or to both. The fact that the appetite usually improved after the first treatment testifies to the rapidity of the x-ray effect. Concomitantly, there is

greater activity, with increased well being, and general improvement in the attitude of the child.

METHOD OF TREATMENT

Four to six roentgen treatments given over a period of three to six weeks usually constitute a course. In only a few instances has the number of treatments been increased to seven or eight. If a second course has been given, which is seldom, it has been because of a stubborn infection recurring months after good response to the first course. The total skin dosage at any one "sitting" has been considered to be less than one-fifth of an erythema dose. Technical factors used are 200 kv., 0.5 mm. Cu + 1.0 mm. Al filter, and 50 cm. target-skin distance.

The first treatment consists of 60 to 70 r over each lateral sinus, the pharynx, and cervical regions. This covers the adenoids, pharynx, tonsils, and cervical lymph node areas. No tissues are screened or protected with this dosage.

The second treatment is given five to seven days later; 75 r are administered as in the first treatment. An additional 10 to 15 r are given to an area centered over the nasopharynx so that it receives a total of 85 to 90 r. All tissues are screened and protected except the nasopharyngeal area, which is treated through a circular portal 6 cm. in diameter.

Seven days later the third treatment is given exactly as the second, with similar protection and dosage.

For the fourth treatment, seven to ten days later, there is an increase in the dosage so that the entire lateral face and cervical area receive 85 to 90 r, while the nasopharynx is given 95 to 110 r.

The fifth and sixth treatments, if required, are given two to three weeks later. The maximum dosage is 110 r to the nasopharynx and 90 r to the cervical and tonsillar area. These two treatments are not usually given and are necessary, as a rule, only in very long standing chronic cases.

Where cough predominates, chest therapy is added with each treatment until the cough disappears: 50 to 60 r are given to the anterior and posterior hilar areas through 10-cm. square ports for the first and second treatments. The succeeding dosages are 125 to 150 r to either the anterior or posterior chest.

In asthmatics with infection predominating over allergy, chest therapy is repeated at monthly intervals in dosages of 100 to 125 r to the anterior or posterior surfaces after a full six-treatment course has been completed.

MODE OF ACTION OF RADIATION

As has been stated, the results of low-dosage treatment are dependent on the presence of infected lymphoid tissue and adjacent tissues which are infiltrated with lymphocytes and leukocytes. It is well known that lymphocytes, polymorphonuclear leukocytes and eosinophils are markedly sensitive to radiation, whereas connective-tissue cells are radioresistant. After exposure to roentgen rays in small dosages, there is an early destruction of infiltrating lymphocytes and leukocytes, liberating antibodies, ferments, and other protective substances from the destroyed cells. Phagocytosis is instituted or increased. Bacteria are destroyed and débris is removed, resulting in resolution of the infection.

The rate of change following irradiation in the different phases of inflammation and infection corresponds to the rate at which lymphocytes, leukocytes, and eosinophils are affected.

Although most often the treatments are administered after everything else has been tried, we do not feel that they could be any more successful even if tried first. This is not true, as a rule, in treating other infections or inflammations.

ARGUMENTS WHICH HAVE BEEN OFFERED AGAINST IRRADIATION

(1) *Enlarged tonsils should be treated surgically:* Children under eight years of age rarely have tonsils with septic foci. Enlargement of the tonsils and

adenoid tissue (sometimes called pharyngeal tonsil) may represent actually, in children, a natural immunity to common respiratory infection. Many of these children have been subjected to surgery in spite of the fact that they were without symptoms. Following surgery, recurrent upper respiratory infections developed, accompanied by a sore throat. We have seen and treated a number of these children, with excellent results. No patient with enlarged non-infected tonsils is subjected to irradiation, because the results are dependent on the presence of infection. The decrease in size of the tonsils and adenoids is due not to a direct action on the lymphoid tissue but to a decrease or complete eradication of infection in the post-pharyngeal area.

We have treated with irradiation many children in whom symptoms persisted after removal of tonsils and adenoids. The fact that irradiation produced such good results, after surgery failed in these patients, makes us feel that removal of the tonsils and adenoids is only one part of the treatment. The source of the infection may not be totally eradicated. The tissues surrounding and adjacent to the tonsils and adenoids are similarly infected but cannot be removed, as this would involve complete removal of the pharynx. The enlarged swollen tonsils and adenoids with pharyngitis should be compared with the swelling of adjacent lymphoid structures accompanying infection elsewhere in the body. Removal of such areas is not justifiable because the source of the infection will not have been removed or eradicated.

The best evidence we can offer to refute this argument is the fact that, where a trial of irradiation was made, it was necessary to remove the tonsils or adenoids in only four cases. On the other hand, we have treated innumerable cases after surgery failed. The good results of irradiation in these cases were all the more apparent because of the failure of surgery.

(*2*) *All tonsils should be removed as a prophylaxis against rheumatic fever:* To our knowledge, no case of rheumatic fever has developed in the children we have treated with radiation, though this statement is made with reservations because of the short time elapsed in most cases and because the number of patients treated is small compared to the number of patients undergoing tonsillectomy. Also, the incidence of rheumatic fever is low in this area as compared to other sections of the country. On the other hand, we have treated successfully a number of patients with recurrent sore throats and colds in whom rheumatic fever developed after the tonsils and adenoids had been removed.

Furthermore, the recent literature on rheumatic fever in children fails to emphasize tonsillectomy as a method of treatment or prophylaxis, or the tonsils as a definite source of this infection. Struthers does not regard rheumatic fever, past or present, as necessarily an indication for the removal of tonsils.

DANGERS AND CONTRAINDICATIONS

With the dosages used by us no dangers are known to accompany irradiation. Since the dosage is low, the time interval between treatments long, and the treatment fields small, no skin changes, systemic reactions, or other deleterious effects have been noted. The eye is tolerant to the usual x-ray dose given to inflammatory tissues. The total skin dosage at any one "sitting" has been considered to be less than one-fifth of an adult erythema dose.

In spite of the fact that a plea is being made to use x-rays more frequently in this condition, such treatment should be carried out only by a qualified roentgenologist or one who has been thoroughly trained in giving x-ray treatments and having the fundamental knowledge of its dangers.

The only contraindications seen in this work are true allergy involving the mucous membranes of the nasopharynx and Vincent's angina. No response to radiation is to be expected in allergy. In Vincent's angina the throat becomes worse and symptoms are accentuated following irradiation.

PATIENTS REFERRED

More than 400 children have been referred by pediatricians and general practitioners for treatments. The following reasons were offered by the referring physicians.

1. Failure to respond to surgical and medical treatment.
2. Recurrent streptococcic infection of the throat in the absence of tonsils and adenoids.
3. Persistent unexplained fever following upper respiratory infections.
4. Poor surgical risk, as patients with (*a*) active rheumatic fever with infected tonsils and adenoids, (b) hemophilia with infected tonsils and adenoids, and (c) congenital heart disease.

RESULTS

Although an accurate statistical report could not be compiled, it can be stated conservatively that not less than 90 per cent of all the children treated showed cure or an otherwise good result. Irradiation produced, in nearly all instances, amelioration of the symptoms for which the child was treated. It has also been noted that perennial colds and sore throats have been eliminated. If a cold does ensue following irradiation, the course is short and not persistent.

To state that the results have been gratifying belittles the enthusiastic attitude of the referring physicians and the gratitude of the parents. We are noticing that we are treating brothers and sisters of children who were treated in the past. The good results have been so consistent, so prompt, and so certain that we find ourselves restraining our enthusiasm so as not to offer too much assurance to the patient. In many instances the mothers have encouraged and requested the family physician to refer the child for irradiation.

After all the failures we see in treating malignant growth with radiation, it is gratifying to get such consistently good results from the use of x-rays in infection of the nasopharynx. These results, however, may be apparent only in this community and may not be duplicated elsewhere. Only by reports from other sections of the country will the value of the method be definitely determined.

SUMMARY

Roentgen irradiation is described as an important method of treatment in chronic infections of post-pharyngeal tissues and tonsils in children because of the results obtainable when medical or surgical methods have failed.

Cough, tonsillitis, and sore throat, cervical adenitis, gagging and vomiting, mouth breathing with nasal obstruction, ear disturbances, and some forms of asthma respond rapidly, with no less than 90 per cent good results.

Because of the low dosage used and the long interval between treatments, the method is considered safe, with no dangers. Four to six treatments are given at five to fourteen-day intervals, using 60 to 90 r to the cervical and tonsillar areas with 85 to 110 r to the nasopharyngeal area.

Because of the high degree of success obtained in this area of the country, Southern Kansas, the method is recommended to other radiologists, who are urged to report their results.

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Fractures Following Electroshock Therapy[1]

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THE INCREASING use of convulsive therapy in various psychoses and allied disorders makes it necessary for the radiologist to be familiar with the roentgen changes that may be found in the complications associated with this form of treatment. The present study was undertaken in order to evaluate the traumatic complications (fractures) incident to electroshock therapy in a group of patients treated at the McLean Hospital. It is intended to emphasize the ways in which the radiologist can be of the greatest assistance to the psychiatrist and orthopedist. The therapeutic value of the treatment as it applies to the same group will not be discussed since it has been adequately presented elsewhere (8, 9).

Since 1935, when Sakel in Vienna first reported insulin shock therapy for psychosis, the value of convulsive treatment has been more and more widely recognized, and the methods of producing shock have been investigated and expanded. Contraindications for and complications from this form of treatment were soon reported. In 1938 Stalker (7) in England and Wespi (10) from the continent each published case reports of severe fractures following convulsive therapy. Similar reports appeared in the American literature a year later. In 1939, Polatin and his associates (6) reported 51 cases of compression fracture of the thoracic vertebrae after metrazol treatment at the New York State Psychiatric Institute. This represented a 43.1 per cent incidence, with most of the cases showing multiple fractures. In all of them the thoracic vertebrae were involved, the number varying from one to eight.

Since 1939 reports of like nature have been frequent. Drug or electroshock therapy undoubtedly produces convulsions that are often severe enough to cause dislocations and fractures not only of the vertebrae, but also of other parts of the bony structures of the body. Fracture of the pelvis, acetabulum, humerus, clavicle, and scapula have been observed. Dislocation of the jaw is not uncommon. The most frequent lesion, however, is in the spinal column, chiefly in the thoracic portion. The incidence of such fractures as reported by various investigators has ranged from zero up to 47 per cent of the patients treated.

Different means for the prevention of the traumatic complications of shock therapy have been advocated—mechanical restraint, *no* restraint, hyperextension, spinal anesthesia, pre-shock paralyzing drugs, as curare and the like. To date none has been entirely successful.

The published reports, both as to the incidence of fractures and as to the need of and the method for prevention, are extensive and contradictory. The consensus appears to be that, as a rule, vertebral fractures, except for pain, are relatively insignificant. Katzenelbogen and his colleagues (5) report the case of a patient who preferred fracture to his depression. Fracture of the long bones is a more serious complication, and fracture of the pelvis may be a cause of permanent disability. Fractures of the femoral necks have been reported fairly frequently (1). Inasmuch as some of them appear to be located subcapitally, patients with tabes (2) or those having a history of previous irradiation to the region of the femoral necks should probably not receive shock therapy.

Easton and Sommers (4) reviewed 800

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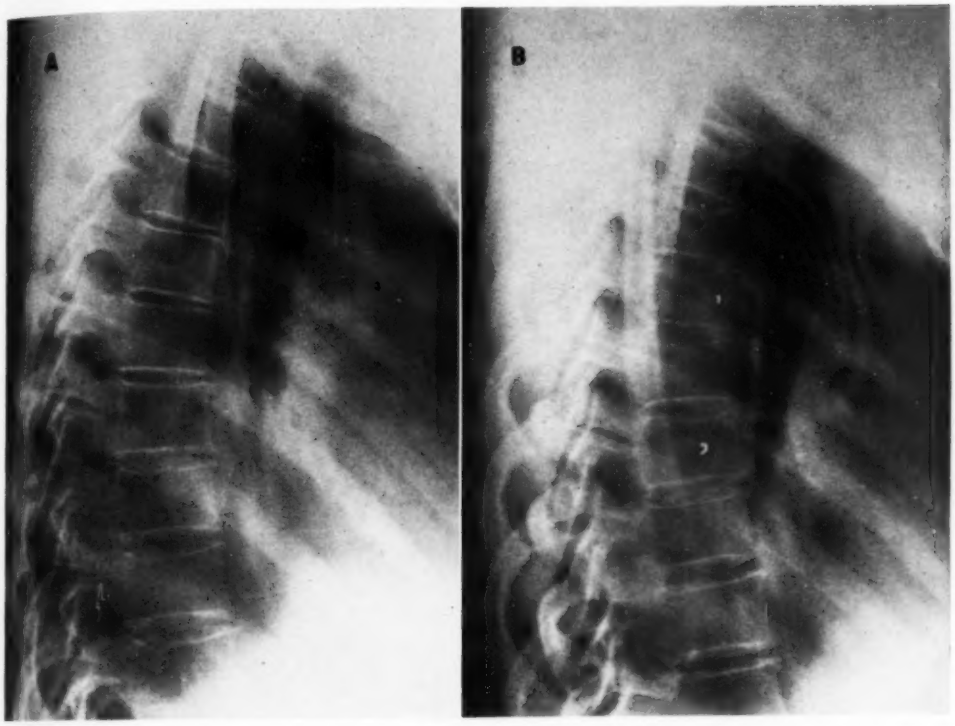

Fig. 1. Roentgenograms of a 35-year-old female who sustained fractures of the second, third, and fourth thoracic vertebrae following one course of electroshock treatments. A. The thoracic spine on July 23, 1945, before treatment. B. The thoracic spine on August 6, 1945, after treatment.

cases treated by shock therapy and compared results, from the point of view of associated fracture, in patients receiving pre-shock curare and in others who did not receive it. Of the entire group, 26.1 per cent sustained fractures of the spine, but in 275 who were given preliminary curare the incidence was only 5.8 per cent. The distribution of the injury remained the same, but the severity of the changes produced was diminished. An unexpected finding was that the highest incidence of fractures in the entire group was not in older patients, but in those under twenty-one years of age, the peak being in the age group twenty to thirty-five years. This substantiates Blumenthal's contention (3) that the muscularity of the patient plays an important part in the causation of fracture. The fourth, fifth, and sixth thoracic vertebrae suffered the greatest number of fractures, and in cases in which osteoporosis was evident before treatment, the incidence of fracture was double that in patients with roentgenologically normal bone texture.

Our study was carried out at the McLean Hospital, Waverley, Mass., covering the months from September 1940 through February 1946. During this period of five and a half years, 230 patients received electroshock therapy, varying from a single treatment to several series of treatments. The electric current applied was calculated to produce a convulsion lasting about forty-five seconds, during which the patient was held by five attendants. No mechanical restraint or preliminary drug paralyzant was used. The attendants were experienced in this work and realized the importance of not holding the subject too rigidly. Their purpose was to absorb the initial shock of the convulsion and prevent sudden hyperflexion of the patient.

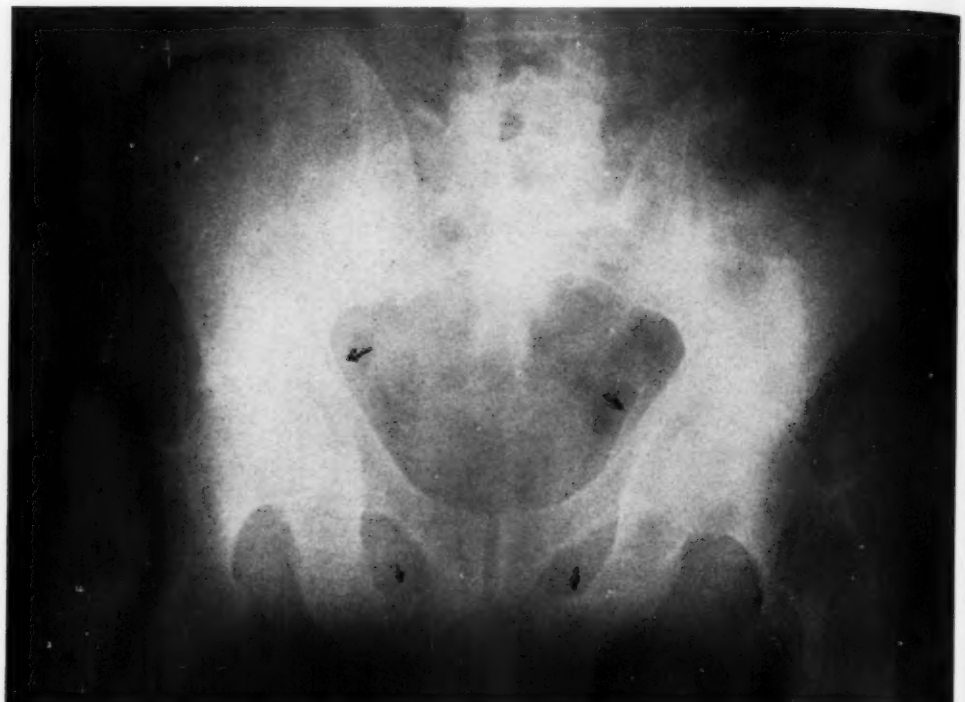

Fig. 2. Roentgenogram of a 65-year-old male who sustained fractures of both acetabula and the descending rami of both pubic bones during one electroshock treatment.

Prior to the entry of the United States into the war, it had been the custom in this institution to make a roentgenologic examination of the thoracic and lumbar portions of the spine before shock therapy in all cases and to repeat the examination on completion of the treatment. In recent years, because of shortage of film and in view of the results of earlier experience, the routine examination after treatment has been omitted. The preliminary roentgenologic examination, however, is always carried out. It had been found that in a patient who complained after treatment of pain in the region of the neck, the cervical spine usually showed no evidence of injury, but further examination often revealed a fracture of one or more of the upper thoracic vertebrae. In place of routine post-shock roentgenograms, examination is now made only of patients who complain of pain or discomfort or show objective signs pointing to vertebral or other lesions. In reporting the incidence of post-shock fractures, therefore, it should be stated that the number is probably under- rather than over-estimated.

Of the group of 230 patients, 53 or 23 per cent sustained fracture of one or more bones. The most frequent involvement was of the spine (49 cases), the number of vertebrae fractured varying from one to five (Fig. 1). Table I lists the incidence of spinal fractures, and shows the marked prevalence in the upper and mid thoracic areas, particularly at the level of T-4 and T-5. In addition to vertebral fractures, there were 3 cases of fractured pelvis. In these cases the acetabula were involved bilaterally, with intrapelvic protrusion of the femoral heads (Fig. 2). Two patients showed pre-existing osteoporosis of bone. The proximal articular surface of the tibia was fractured in one case (this patient also

TABLE I: ANALYSIS OF VERTEBRAL FRACTURES ASSOCIATED WITH ELECTROSHOCK

Vertebra	Number of Times Fractured
C-4	1
T-2	2
T-3	15
T-4	35
T-5	31
T-6	14
T-7	4
T-8	2
T-9	0
T-10	1
T-11	0
T-12	1
L-1	1
L-2	1
L-3	0
L-4	1
L-5	1
TOTAL	110

showed bone decalcification before treatment); in another, fracture of the sternum occurred (Fig. 3).

Our experience agrees with that of others in regard to the sex incidence of post-shock fractures, the ratio being about 3 males to 1 female. Of 94 males treated, 35 or 37.2 per cent suffered fracture; among 136 females there were only 18 with fractures, or 13.2 per cent. Easton and Sommers' findings as to age and bone atrophy before treatment were also confirmed in our group. Fracture occurred most commonly in the young and in the old (Table II) and was more frequent in patients showing bone atrophy before treatment. Twenty-one of the group showed on pre-treatment examination varying degrees of bone decalcification, and 9 or 43 per cent of these sustained fracture. This is in contrast to a 21 per cent incidence if the osteoporotic cases are omitted. In young patients, muscularity appears to be a causative factor; in the old, decalcification of bone predisposes to fracture.

TABLE II: AGE INCIDENCE OF CONVULSIVE SHOCK FRACTURES

Decades	Number Patients	Number Fractures
11-20 years	7	2 (28.5%)
21-30 years	45	12 (26.6%)
31-40 years	51	10 (19.6%)
41-50 years	63	8 (12.7%)
51-60 years	35	9 (25.7%)
61-70 years	25	9 (36.0%)
71-80 years	4	3 (75.0%)
TOTAL	230	53 (23.0%)

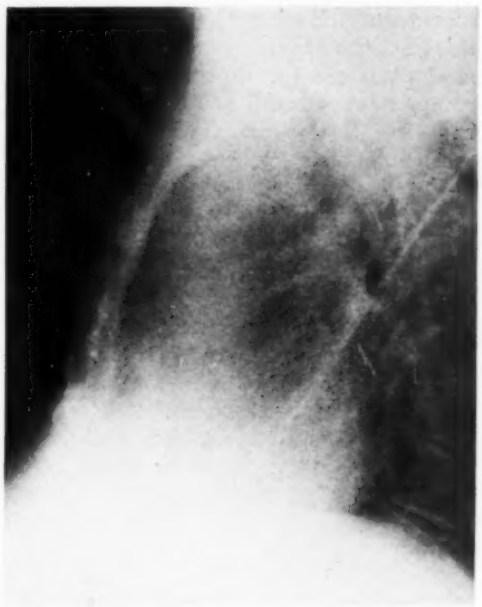

Fig. 3. Roentgenogram of a 72-year-old female who sustained fracture of the sternum during electroshock treatment. Two months previously, during treatment, she had sustained fractures of the fourth and fifth lumbar vertebrae.

Study of a group of 35 cases in which examination had shown old fractures of the vertebrae revealed that in the majority no change in the appearance of the fracture followed treatment. Two patients, however, showed an increase in the degree of compression of the affected vertebra. In the remainder of the group, if a new fracture was sustained, another vertebra rather than the one formerly involved was affected.

In the older age group, though extensive spur formation and other degenerative changes throughout the thoracic and lumbar spine were present before treatment, no correlation with subsequent fracture was found, nor was change in the already existing abnormalities noted.

Two patients with known Paget's disease were in the group treated. In one, with Paget's disease of L-2 and of the pelvis, fractures of T-3 and T-4 followed the first

treatment. During the next two years this patient received several series of treatments and, except for slight increase in the compression of the fractured vertebrae, experienced no further ill effect. The second patient, whose disease involved T-11 and the left femur, sustained no bony injury during his treatment. Incidentally, a 14-year-old boy, showing acute epiphysitis of the thoracic spine, received electroshock treatment without complication of any kind.

At this hospital, convulsive shock fracture was not considered as a contraindication for future treatment. Fifteen patients who sustained fractures early in the course of treatment were continued on the original plan of therapy, and in only 3 was any increase in the compression observed.

CONCLUSIONS

Of 230 patients who received electroshock therapy at the McLean Hospital during a period of five and a half years, 53 or 23 per cent sustained fracture, predominantly of the vertebrae. A total of 110 fractured vertebrae were found. The incidence of fracture was greater in males than in females, and in the younger and older, rather than in the middle, age groups. It would seem, from our experience, that whether the convulsion is due to tetanus, epilepsy, therapeutic metrazol and allied drugs, or to electroshock, the number of bones fractured and the areas involved are probably dependent to a great extent upon the *severity* of the convulsion sustained.

Certain pre-existing bone conditions appear to contraindicate shock therapy, inasmuch as their presence renders the bone more susceptible to fracture than normal bone. Such lesions include osteoporosis, malignant lesions, Otto's pelvis, possibly Paget's disease, and syphilitic lesions.

NOTE: This study was made possible through the courtesy and co-operation of Dr. K. J. Tillotson and the late Dr. W. Sulzbach. Thanks are also due to Mr. Herbert Davidson for his assistance and his painstaking technic.

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Cardiac Enlargement[1]

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No aspect of heart disease has a more venerable history than cardiac enlargement, which was recognized as an indication of heart disease by the technic of palpation, and later percussion, long before other instruments of diagnosis became available. Within a few years after the advent of roentgenology, several comprehensive studies on cardiac enlargement were carried out by Moritz, Dietlen, and others, to which, in fact, relatively little has been added. Although roentgenologic study makes it possible to visualize and to explore the heart in a manner not approached by any other means, it is a fact that x-ray study of the heart in general and several aspects of proved value in particular are not utilized in clinical medicine to the extent of their potentialities. I feel that in no small measure a cause for this lies with roentgenologists and cardiologists themselves. Scarcely a year passes in which some enthusiast does not add new measurements and indices of one sort or another to an already overburdened literature. The net result has been to confuse rather than to clarify the subject, and it is small wonder that so many have come to feel that cardiac mensuration is a field of idle sophistry and employ no measurement other than the estimate of the unaided eye. The truth is that a few well tried, simple measurements introduced shortly after Roentgen's discovery suffice entirely to determine whether cardiac enlargement is present. It has been our object in the studies we have carried out to standardize the few measurements that appear most useful and to make them available in a simple form which may be readily employed. Some of you may be familiar with the nomogram chart we have devised for this purpose, which we will presently discuss.

It would be well first to define the sphere of usefulness of cardiac measurements. Measurements are of greater value as an index of generalized enlargement of the heart than in determining the size of the individual chambers. There is a definite field of usefulness for measurement standards in evaluating enlargement of the heart as a whole, since in many instances the individual chambers are not involved distinctly, and one can state only that the heart is enlarged. Mensuration is unnecessary when gross enlargement exists, but lesser degrees of enlargement often escape detection on inspection. Conversely, an apparently large cardiac shadow may assume less significance when it is considered in relation to standards of body build. If proper account is taken of the physiological variables which influence the size of the heart, mensuration is a valuable aid in determining whether enlargement exists. Measurement is helpful, also, in comparison of changes in heart size in serial examinations in the same subject. Another field where measurement has found wide application is in physiological and pharmacological investigations of the heart.

The size, shape, and position of the heart are influenced by certain physiological variables and technical considerations which should be appreciated before deciding whether the heart is pathologically enlarged. Most measurements refer to the frontal cardiac silhouette. It is important, therefore, that the subject be centered properly, and this can be recognized in the roentgenogram by an equidistance of the inner borders of the clavicles from the mid-

[1] From the Medical Department, Equitable Life Assurance Society of the United States, New York City. Presented before the joint meeting of the New England X-Ray Society and the New England Heart Association, March 15, 1946.

point of the vertebral spine. Even slight degrees of rotation may significantly alter the size of the cardiovascular shadow, particularly the aortic arch silhouette. The exposure should be made in the erect or sitting position and with respiration suspended in ordinary inspiration, since extremes of respiration or straining may cause marked variations in heart size. The size of the heart varies greatly from systole to diastole, as seen in the roentgenkymogram. Since diastole is longer than systole at ordinary heart rates, roentgenograms are more often exposed in diastole. It is not true, as is widely supposed, that a full second exposure lasting through a complete cardiac cycle will record the diastolic or largest heart shadow.

Several anatomical peculiarities may cause confusion in interpreting the heart size. The most important is an extrapericardial fat pad which merges with the lower left heart border and may obscure the apex. The margin of the fat pad must not be mistaken for the left heart border, which may be discerned within the fat pad, particularly if the roentgenogram is made with slightly over-penetrated technic. Skeletal abnormalities of the thorax, such as funnel chest and kyphoscoliosis, by displacing and distorting the heart, occasionally may render difficult the accurate determination of its size. The scoliotic spine may simulate the heart border, and a diagnosis of cardiac enlargement or dilatation of the aorta may thereby be made erroneously. The size, shape, and position of the cardiac shadow may be altered in pulmonary diseases, such as fibroid phthisis, atelectasis, pneumothorax, etc., and by elevation of the diaphragm, as in pregnancy and ascites.

Body build has a most important determining influence on the size of the heart. The correlation of heart size with various factors, such as weight, height, surface area, muscular development, thoracic circumference and other thoracic measurements, etc., has been probed extensively. The dependence on weight is somewhat greater than on height, but the correlation is improved if both weight and height are considered. A weight/height index has been evolved which appears to serve as a satisfactory coefficient for prediction of normal standards. The influence of sex, and of age in adults, on the size of the heart is relatively small compared with the factors of weight and height, and for practical purposes may be disregarded in prediction standards.

Of the many measurements that have been advocated, the best known are the transverse, longitudinal, and broad diameters. These few simple measurements suffice to determine whether the heart is enlarged. The transverse diameter, and the area of the frontal cardiac silhouette, which may be determined from the long and broad diameters, as we will presently show, are the most thoroughly tried and standardized and among the best of all measurements. In addition, the heart volume, which is of great physiological interest, can be accurately calculated from these diameters.

The simplest, most widely employed, and one of the most useful measurements is the transverse diameter, which is the sum of the greatest extension of the right border to the right, and of the left border to the left, of the midline. The cardiothoracic ratio, which is predicated on the assumption that the transverse diameter should be less than half the transverse diameter of the chest at the level of the diaphragm, has been widely popularized, but is crude and inexact. The width of the thorax is only a rough index of body stature and, in any given case, is altered by respiration and also in pathologic conditions, such as emphysema. Ordinarily the transverse diameter of the heart is considerably less than half the transverse diameter of the chest, so that appreciable enlargement may escape detection if this ratio is employed as an index of heart size. More accurate standards, based on weight and height, have been established both for the orthodiagram by Hodges and Eyster (1) and for the teleroentgenogram by Ungerleider and Clark (2). Teleroentgenographic standards are slightly greater than those for the

orthodiagram, so that it is not proper to use the orthodiagram values in reading teleroentgenograms. Because of the increasing employment of the teleroentgenogram, a new prediction table, based on a study of 1,460 teleroentgenograms of normal subjects, was prepared, and this should be employed, rather than the older orthodiagram standards, when reading teleroentgenograms (see table on next page).

The actual transverse diameter should not be interpreted too strictly in relation to the predicted value, for there are appreciable physiologic variations in the size of the cardiac shadow in addition to changes due to the phase of the heart cycle and to respiration. Diameters which are more than 10 per cent above the predicted value should be regarded as abnormal, and the heart may be considered as almost certainly enlarged if the transverse diameter is over 15 per cent in excess of the predicted diameter, since less than 3 per cent of normals exceed this limit. An increase in the transverse diameter is most often caused by enlargement of the left ventricle, but enlargement of any of the cardiac chambers, even of the left auricle, when it forms the right border of the heart, can widen the transverse diameter.

The utility of the transverse diameter, employing our tables, has been confirmed in several studies. The conclusion of Comeau and White (3) in their article entitled "A Critical Analysis of Standard Methods of Estimating Heart Size from Roentgen Measurements" may be quoted.

"1. A comparison of transverse diameters, frontal cardiac area, and heart volumes in 200 normal hearts leads us to conclude that the transverse diameter of the heart compares favorably with the other actual heart measurements and is the most satisfactory from the clinical standpoint.

"2. We believe that the cardiothoracic ratio is not sufficiently reliable to warrant the wide usage which it now enjoys and that it should be discarded in view of the fact that it has been superseded by a more accurate and an equally simple correlative method.

"3. We have found that the prediction tables offer the best approach to the problem of determining whether cardiac enlargement exists in an individual case. Our results indicate that the use of the transverse heart diameter and its deviations from the predicted normal is as yet the most reliable and the most applicable clinically of the existent methods."

Recently an important study was carried out by Sherman and Ducey (4), in which a direct comparison was made between the weight of the heart at autopsy, in 200 adult males, and three types of measurement; the Ungerleider and Clark transverse diameter prediction table, the Newcomer heart-lung rectangle method, and the cardiothoracic ratio. Their findings were reported as follows:

"The values obtained by the Ungerleider method more closely approximate the enlargement by weight than do those by the other two methods, particularly in borderline cases. The Ungerleider method is the only one of the three by which enlargement of 40 per cent or less can be detected. There is constant correlation between the percentage deviation of the transverse diameter, as obtained by the Ungerleider method, and the percentage deviation in heart weight."

Two other diameters, the long and broad diameters, are well known, although these are somewhat less valuable individually than the transverse diameter. The long diameter extends from the junction of the cardiac and vascular silhouette on the upper part of the right border of the heart obliquely downward to the apex on the left. This diameter, which is approximately 10 per cent greater than the transverse diameter, is increased chiefly as a result of left ventricular enlargement. The broad diameter is the greatest diameter perpendicular to the long diameter. The broad diameter is often drawn as the sum of the two perpendiculars from the long diameter to the lower right and upper left heart borders, but properly it is the greatest single diameter from upper left to lower right heart border perpendicular to the long diameter. If the heart is placed transversely, it may be necessary to extend the lower part of the right border slightly below the diaphragm in its natural curve in order to delineate the limit of the broad diameter. The broad diameter averages about 15 per cent less than the transverse diameter.

Theoretical Transverse Diameters of Heart Silhouette for Various Heights and Weights

T. D. of Heart	HEIGHT												6'0"	1"	2"	3"	4"	5"	6"
	5'0"	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"							
100 mm	83	85	86	87	89	90	92												
101 "	85	86	88	89	91	92	93	95											
102 "	87	88	90	91	92	94	95	97											
103 "	88	90	92	93	94	96	97	99	100										
104 "	90	92	93	95	96	98	99	101	102										
105 "	92	93	95	96	98	99	101	103	104	106									
106 "	94	95	97	98	100	101	103	104	106	108									
107 "	95	97	99	100	102	103	105	106	108	110	111								
108 "	97	99	100	102	104	105	107	108	110	112	113								
109 "	99	101	102	104	106	107	109	110	112	114	115	117							
110 "	101	102	104	106	108	109	111	113	114	116	118	119	121						
111 "	103	104	106	108	109	111	113	115	116	118	120	121	123	125					
112 "	105	106	108	110	111	113	115	117	118	120	122	124	125	127	129				
113 "	106	108	110	112	113	115	117	119	121	123	124	126	128	129	131	133			
114 "	108	110	112	114	115	117	119	121	123	125	126	128	130	132	133	135	137		
115 "	110	112	114	116	117	119	121	123	125	127	129	130	132	134	136	138	140	141	
116 "	112	114	116	118	120	121	123	125	127	129	131	133	134	136	138	140	142	144	146
117 "	114	116	118	120	122	124	125	127	129	131	133	135	137	139	141	143	144	146	148
118 "	116	118	120	122	124	126	128	129	131	133	135	137	139	141	143	145	147	149	151
119 "	118	120	122	124	126	128	130	132	134	136	138	140	142	143	145	147	149	151	153
120 "	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156
121 "	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	159
122 "	124	126	128	130	132	134	136	138	140	143	145	147	149	151	153	155	157	159	161
123 "	126	128	130	132	134	136	139	141	143	145	147	149	151	153	155	157	160	162	164
124 "	128	130	132	134	137	139	141	143	145	147	149	152	154	156	158	160	162	164	166
125 "	130	132	134	137	139	141	143	145	147	150	152	154	156	158	160	163	165	167	169
126 "	132	134	137	139	141	143	145	148	150	152	154	156	159	161	163	165	167	170	172
127 "	134	137	139	141	143	146	148	150	152	154	157	159	161	163	166	168	170	172	175
128 "	136	139	141	143	146	148	150	152	155	157	159	161	164	166	168	171	173	175	177
129 "	139	141	143	146	148	150	152	155	157	159	162	164	166	169	171	173	176	178	180
130 "	141	143	145	148	150	152	155	157	160	162	164	167	169	171	174	176	178	181	183
131 "	143	145	148	150	152	155	157	160	162	164	167	169	172	174	176	179	181	183	186
132 "	145	148	150	152	155	157	160	162	164	167	169	172	174	177	179	181	184	186	189
133 "	147	150	152	155	157	160	162	165	167	169	172	174	177	179	182	184	187	189	192
134 "	150	152	155	157	160	162	164	167	169	172	174	177	179	182	184	187	189	192	194
135 "	152	154	157	159	162	164	167	169	172	175	177	180	182	185	187	190	192	195	197
136 "	154	157	159	162	164	167	169	172	175	177	180	182	185	187	190	193	195	198	200
137 "	156	159	162	164	167	169	172	175	177	180	182	185	188	190	193	195	198	201	203
138 "	159	161	164	167	169	172	174	177	180	182	185	188	190	193	196	198	201	204	206
139 "	161	164	166	169	172	174	177	180	182	185	188	190	193	196	198	201	204	206	209
140 "	163	166	169	171	174	177	180	182	185	188	190	193	196	199	201	204	207	209	212
141 "	166	168	171	174	177	179	182	185	188	190	193	196	199	201	204	207	210	212	215
142 "	168	171	174	176	179	182	185	188	190	193	196	199	202	204	207	210	213	216	218
143 "	170	173	176	179	182	184	187	190	193	196	199	202	204	207	210	213	216	219	221
144 "	173	176	178	181	184	187	190	193	196	199	201	204	207	210	213	216	219	222	224
145 "	175	178	181	184	187	190	193	196	198	201	204	207	210	213	216	219	222	225	228
146 "	178	180	183	186	189	192	195	198	201	204	207	210	213	216	219	222	225	228	231
147 "	180	183	186	189	192	195	198	201	204	207	210	213	216	219	222	225	228	231	234
148 "	182	185	188	192	195	198	201	204	207	210	213	216	219	222	225	228	231	234	237
149 "	185	188	191	194	197	200	203	206	210	213	216	219	222	225	228	231	234	237	240
150 "	187	191	194	197	200	203	206	209	212	215	219	222	225	228	231	234	237	240	243
151 "	190	193	196	199	203	206	209	212	215	218	222	225	228	231	234	237	241	244	247
152 "	192	196	199	202	205	208	212	215	218	221	224	228	231	234	237	241	244	247	250
153 "	195	198	201	205	208	211	214	218	221	224	227	231	234	237	240	244	247	250	253
154 "	198	201	204	207	211	214	217	221	224	227	230	234	237	240	244	247	250	253	257
155 "	200	203	207	210	213	217	220	224	227	230	233	237	240	243	247	250	253	257	260
156 "		206	210	213	216	220	223	227	230	233	236	240	243	247	250	254	257	260	264
157 "				216	219	222	226	229	233	236	239	243	246	250	253	257	260	263	267
158 "						225	229	232	236	239	243	246	249	253	256	260	263	267	270
159 "								235	239	242	246	249	253	256	260	263	267	270	274
160 "										245	249	252	256	259	263	266	270	274	277
161 "												255	259	263	266	270	273	277	281
162 "												259	262	266	270	273	277	280	284
163 "														269	273	277	280	284	288
164 "														273	276	280	284	287	291

Refer to paper entitled "A Study of the Transverse Diameter of the Heart Silhouette with Prediction Table Based on the Teleoroentgenogram" presented to the Association of Life Insurance Medical Directors of America by Dr. Harry E. Ungerleider of the Equitable Life Assurance Society, and Dr. Charles F. Clark, of the Mutual Benefit Life Insurance Company (1938)

Table for Determining the Per Cent. Deviation from Average

Minus					Average	Plus				
25%	20%	15%	10%	5%	%	5%	10%	15%	20%	25%
75	80	85	90	95	100	105	110	115	120	125
76	81	86	91	96	101	106	111	116	121	126
77	82	87	92	97	102	107	112	117	122	128
77	82	88	93	98	103	108	113	118	124	129
78	83	88	94	99	104	109	114	120	125	130
79	84	89	95	100	105	110	116	121	126	131
80	85	90	95	101	106	111	117	122	127	133
80	86	91	96	102	107	112	118	123	128	134
81	86	92	97	103	108	113	119	124	130	135
82	87	93	98	104	109	114	120	125	131	136
83	88	94	99	105	110	116	121	127	132	138
83	89	94	100	105	111	117	122	128	133	139
84	90	95	101	106	112	118	123	129	134	140
85	90	96	102	107	113	119	124	130	136	141
86	91	97	103	108	114	120	125	131	137	143
86	92	98	104	109	115	121	127	132	138	144
87	93	99	104	110	116	122	128	133	139	145
88	94	99	105	111	117	123	129	135	140	146
89	94	100	106	112	118	124	130	136	142	148
89	95	101	107	113	119	125	131	137	143	149
90	96	102	108	114	120	126	132	138	144	150
91	97	103	109	115	121	127	133	139	145	151
92	98	104	110	116	122	128	134	140	146	153
92	98	105	111	117	123	129	135	141	148	154
93	99	105	112	118	124	130	136	143	149	155
94	100	106	113	119	125	131	138	144	150	156
95	101	107	113	120	126	132	139	145	151	158
95	102	108	114	121	127	133	140	146	152	159
96	102	109	115	122	128	134	141	147	154	160
97	103	110	116	123	129	135	142	148	155	161
98	104	111	117	124	130	137	143	150	156	163
98	105	111	118	124	131	138	144	151	157	164
99	106	112	119	125	132	139	145	152	158	165
100	106	113	120	126	133	140	146	153	160	166
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101	108	115	122	128	135	142	149	155	162	169
102	109	116	122	129	136	143	150	156	163	170
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105	112	119	126	133	140	147	154	161	168	175
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107	114	122	129	136	143	150	157	164	172	179
108	115	122	130	137	144	151	158	166	173	180
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116	123	131	139	146	154	162	169	177	185	193
116	124	132	140	147	155	163	171	178	186	194
117	125	133	140	148	156	164	172	179	187	195
118	126	133	141	149	157	165	173	181	188	196
119	126	134	142	150	158	166	174	182	190	198
119	127	135	143	151	159	167	175	183	191	199
120	128	136	144	152	160	168	176	184	192	200
121	129	137	145	153	161	169	177	185	193	201
122	130	138	146	154	162	170	178	186	194	203
122	130	139	147	155	163	171	179	187	195	204
123	131	139	148	156	164	172	180	188	196	205

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The long and broad diameters are of interest, not so much by themselves, but for their product, *i.e.*, the frontal cardiac area, which is an expression of the two-dimensional size of the cardiac shadow.

The area of the frontal cardiac silhouette in relation to standards based on weight and height has been widely recommended as an excellent criterion of the size of the heart. In order to ascertain the area of the frontal silhouette, the upper and lower limits of the heart shadow must be completed by arbitrary and imaginary lines, and this requires considerable experience to attain duplicable results. The area is measured by means of a planimeter, or by counting squares within the area on cross-section paper. In orthodiagraphic examination, observation of the pulsations helps in outlining the upper and lower limits of the heart contour. In the teleroentgenogram, however, the error in completing the upper and lower borders is much greater, and, for that reason, satisfactory frontal area measurements have not hitherto been obtained from the teleroentgenogram, although this method yields excellent results in orthodiagraphy in the hands of those who are well trained in the technic. Inasmuch as the cardiac shadow is ellipsoid in shape, its area may be calculated from the product of its axial long and broad diameters (area of ellipse $= \pi/4$ long $\times$ broad diameters). Calculation of the cardiac area by means of the formula, $\pi/4$ long $\times$ broad diameters, yields values which correspond closely to the actual area as measured by planimetry (within 3 per cent) (5). This product may, therefore, be used to estimate the cardiac area in lieu of planimetry. This is of particular advantage in the teleroentgenogram, because the long and broad diameters can be measured accurately, whereas the planimetric estimation of the cardiac area is less accurate. The product, $2/3$ long $\times$ transverse diameters, approximates the cardiac area, but is less satisfactory than the product of long and broad diameters, for the mean deviation from actual areas, as ascertained by planimetry in 134 orthodiagrams, was found to be 7 per cent, whereas with the long and broad diameter product the mean deviation in the same group of 134 cases was less than 3 per cent. The actual cardiac area should not exceed 10 per cent over the predicted value; if it does, the heart may be considered enlarged. Recently we prepared a nomogram for prediction of the cardiac area from weight and height, and actual area as calculated from the long and broad diameters (5). The nomogram permits the frontal area to be read directly, without calculation from the long and broad diameter measurements. Predicted values for the frontal area based on weight and height are indicated in the same nomogram chart on another scale (see next page).

The validity and usefulness of the nomogram for frontal area has been confirmed by Kurtz (6) on the basis of 155 cases tested. Kurtz reported: "This relatively close approximation to the planimetric area indicates that the method has a practical application of distinct value in the great majority of cases." He states further:

> "Most cardiologists will admit that the cardiothoracic ratio is the poorest roentgenographic method of detecting cardiac enlargement, whereas orthodiascopic measurement of the frontal area of the cardiac silhouette is probably the most accurate. The latter has the obvious disadvantage of requiring a considerable amount of training in the technique. If the other disadvantages of measuring the frontal area, namely, the completing of the upper and lower borders and the use of a planimeter, could be obviated one would have an ideal method for even the untrained. The method proposed by Ungerleider and Gubner approaches the ideal."

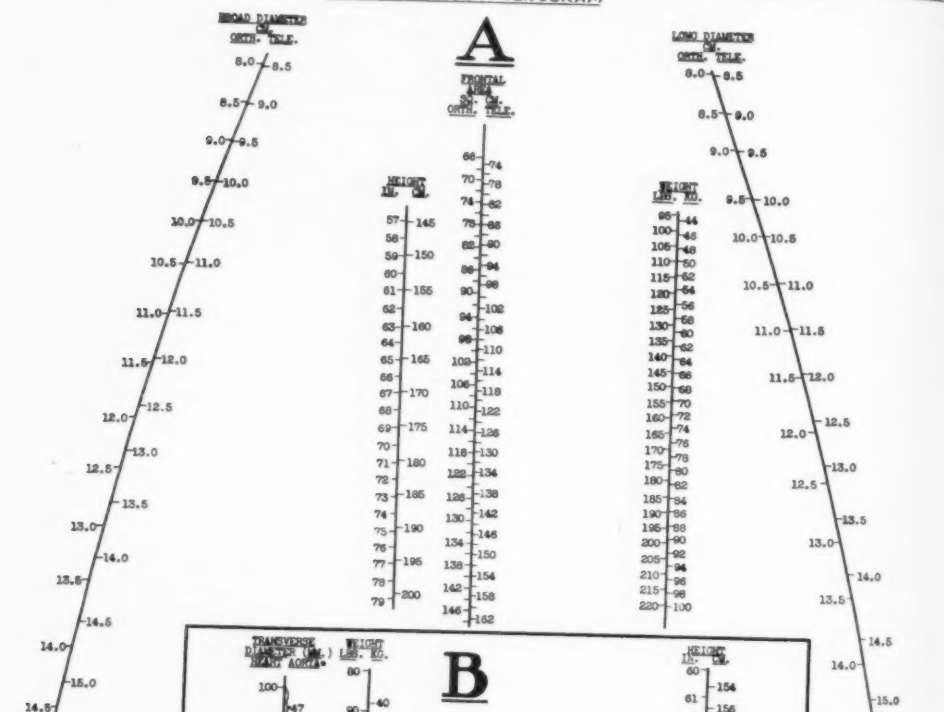
To summarize our discussion of cardiac measurements, it is evident that with the use of either or both the transverse diameter and the nomographic determination of frontal area, we have two simple and accurate methods which suffice to determine whether cardiac enlargement is present.

Roentgenologic examination of the heart should invariably include observation of the aorta, for abnormalities such as widening, tortuosity, and calcification occur frequently in heart disease, particularly in

Nomograms for Area and Transverse Diameter of frontal heart silhouette

A. PREDICTED AREA FROM WEIGHT AND HEIGHT[1] AND ACTUAL AREA FROM LONG AND BROAD DIAMETERS ($A=\frac{\pi}{4}L\times B$); FOR ORTHODIAGRAM AND TELEOROENTGENOGRAM.

B. TRANSVERSE DIAMETER OF HEART[2] AND AORTIC SILHOUETTE[3] PREDICTED FROM WEIGHT AND HEIGHT; FOR TELEOROENTGENOGRAM


A
BROAD DIAMETER CM. ORTH. TELE.
FRONTAL AREA SQ. CM. ORTH. TELE.
LONG DIAMETER CM. ORTH. TELE.
HEIGHT LBS. KG.
HEIGHT IN. CM.
B
TRANSVERSE DIAMETER (CM.) HEART AORTA*
WEIGHT LBS. KG.
HEIGHT IN. CM.
FOR AORTIC DIAMETER ADD 1 MM. FOR EACH 3 YRS. OVER AGE 43 AND SUBTRACT 1 MM. FOR EACH 3 YRS. UNDER 43.

THE VALUES FOR ACTUAL (OR PREDICTED) AREA ARE READ AT THE POINT AT WHICH A STRAIGHT LINE EXTENDING FROM THE LONG AND BROAD DIAMETERS (OR WEIGHT AND HEIGHT) INTERSECTS THE CARDIAC AREA SCALE. ORTHODIAGRAM VALUES ARE ON THE LEFT, TELEOROENTGENOGRAM VALUES ON THE RIGHT. IN THE LOWER NOMOGRAM THE PREDICTED TRANSVERSE DIAMETER OF THE HEART (LEFT SIDE OF SCALE) OR AORTIC ARCH (RIGHT SIDE OF SCALE) IS OBTAINED AS AN EXTENSION OF A STRAIGHT LINE CONNECTING HEIGHT AND WEIGHT. A CORRECTION FOR AGE, AS INDICATED, IS NECESSARY FOR THE AORTIC DIAMETER.

hypertensive and arteriosclerotic heart disease and in syphilis. Measurement of the true caliber of the aorta is difficult, because both contours are not visualized in the frontal position. The left border of the descending aortic arch is visualized in the frontal roentgenogram, and, if the esophagus is filled with barium, the right border of the aorta is indicated by the aortic indentation of the esophagus; therefore, the diameter at this level of the aorta can be ascertained by subtracting 2 mm., representing the thickness of the esophageal wall (Kreuzfuchs' method). The method is not dependable when the aorta is tortuous and the aortic knob projects to the left. Where a portion of the aortic knob is distinct, as is usually the case in adults, the true diameter of the aorta at this level may be ascertained by the simple method we have proposed, of completing the circle, of which the aortic knob is an arc, by means of a compass (7). The caliber of the aorta determined by this simple procedure checks exactly with the diameter obtained by visualization of the aorta in the left anterior oblique position and with the Kreuzfuchs' method. The diameter of the transverse arch of the aorta can frequently be measured directly in the left anterior oblique position, particularly when some degree of emphysema is present to aid contrast, or when overpenetration technic is employed. The diameter of the aorta at this level averages 3.0 to 3.5 cm. in adults, varying from 2.0 to 4.0 cm., depending on body build and age.

These methods indicate the size of the transverse and descending aortic arch, but it is the ascending aorta which is most often enlarged in disease. The first portion of the ascending aorta is buried in the cardiac shadow and cannot be studied by any means except contrast visualization with diodrast. The diameter of the ascending aorta just above the aortic valve normally is 25 per cent greater than the diameter of the transverse arch at the level of the aortic knob. The ratio does not hold in pathological states, as the ascending aorta usually becomes dilated to a much greater degree than the transverse or descending arch. Enlargement of the ascending aorta is evidenced by prominence of the right border of the vascular pedicle and by a forward bulge of the anterior border of the aorta above the cardiac shadow as observed in the left anterior oblique view.

The right border of the vascular pedicle is formed by the superior vena cava in the majority of young subjects; in later life it is more frequently formed by the right border of the ascending aorta. An increase in the transverse diameter of the vascular pedicle in the frontal roentgenogram does not specifically indicate enlargement of the aorta, for this may result from tortuosity alone; however, this measurement is useful in that it does distinguish between a normal and abnormal aorta. In a recent study, it was found that the transverse aortic diameter in normal subjects is closely related to weight and height. The table established for predicting the transverse diameter of the heart from weight and height may be employed equally well for the aortic arch diameter (8). A correction for age is necessary; 1 mm. is added for each three years over the age of 43, and subtracted for each three years under the age of 43. Deviations from the predicted value up to 10 per cent are within allowable normal limits, but deviations in excess of this are infrequently seen, and the aorta may be considered as almost certainly abnormal if the diameter exceeds 15 per cent above the predicted value, for 92 per cent of normal subjects fall within this range. The transverse diameter of the aortic arch is a simple and valuable standard for measurement of the aorta. It is important that the roentgenogram be made with the subject properly centered, for even slight rotation into the oblique positions markedly alters the diameter. If it is found to exceed normal values, further study in the left anterior oblique position is indicated, for the aortic arch is best visualized in this view.

Interpretation of the heart size should not be confined to measurements. As far as is possible, enlargement should be de-

scribed in terms of the chambers involved since characteristic changes occur in various types of heart disease. As stated above, measurements are of greater value as an index of generalized enlargement of the heart than in determining the size of the individual chambers. Diodrast visualization of the cardiac chambers makes more detailed study possible, but this highly specialized technic is not likely to be widely employed. The relation of the heart to adjacent structures such as the esophagus and bronchi, as determined by fluoroscopy or teleroentgenography in frontal and oblique positions, is of greater value than mensuration in detecting enlargement of the individual chambers.

Fluoroscopy, technically the simplest as well as most generally available of roentgenologic procedures, provides the most information and should precede any further x-ray study. Fluoroscopy is not well suited, however, for absolute measurement of the heart size, since the image is considerably magnified, due to divergence of the x-ray beam as a result of the short tube-film distance usually employed in fluoroscopic examination. The degree of magnification depends not only on the tube-film distance, but on the object-film distance, as well. Magnification is, accordingly, greater in subjects with deep chests, in whom the heart contours are further removed from the film, than in slender subjects and children.

Magnification can be obviated by orthodiascopy or by a simple procedure we have previously described (9). A lead scale placed vertically parallel to the cassette alongside the subject, in the plane of the anterior axillary line, is magnified exactly in the same proportion as is the heart silhouette. The scale is recorded with the heart in the same exposure of the fluoroscopic screen or roentgenogram and serves as a reference scale for measurement of the heart size. This procedure is equally suitable for 35-mm. or 4×5-inch photographs of the fluoroscopic image, a technic which is being increasingly employed, particularly in military and industrial surveys.

It may be of interest to review certain aspects of enlargement of the individual heart chambers. The four cardiac chambers are individual functional units and react independently to the strain imposed by various lesions. Abnormalities in the cardiac configuration should always be considered in terms of the chambers involved. It is more informative to describe the individual chambers specifically than to employ less precise phrases, such as enlargement to the left or to the right, or such terms as "mitral" or "aortic" configuration. The shadows of the separate chambers merge imperceptibly in the cardiac shadow, but the contours in frontal and oblique projections permit adequate differentiation and visualization of all the chambers.

The configuration of the enlarged left ventricle varies somewhat depending on whether hypertrophy or dilatation predominates. In the earlier stages of hypertensive heart disease, for example, there may be considerable myocardial hypertrophy with relatively little dilatation (concentric hypertrophy). Hypertrophy as such is a matter of increase in the thickness of the left ventricle of only a few millimeters and so does not perceptibly alter the dimensions of the cardiac shadow. The left ventricular border, however, is characteristically altered in concentric hypertrophy, becoming increasingly convex, *i.e.*, more rounded.

Enlargement of the left ventricle occurs downward, laterally, and posteriorly. Downward enlargement is recognized by elongation of the left ventricular contour, the apex extending to the sixth intercostal space. This type of enlargement is seen particularly in aortic insufficiency, where dilatation of the left ventricular cavity predominates, the diastolic volume necessarily being large because of the increased systolic output. Enlargement of the left ventricle laterally is evident by extension of the left ventricular border outside the midclavicular line. This criterion is the one regularly employed on physical examination, but can be applied even more accurately

in the roentgenogram. Posterior enlargement of the left ventricle is best evaluated on fluoroscopic examination in the left anterior oblique position. On rotation into that position, the posterior surface of the left ventricle clears the anterior border of the spine at an angle not greater than 60 degrees. When marked enlargement is present, the left ventricular border may not clear the spine even on rotation into the full left lateral position. While enlargement laterally, downward, or posteriorly may predominate in slight degrees of enlargement, extension of the left ventricular border in all directions occurs in more advanced stages.

It is not generally appreciated that the electrocardiogram is more sensitive than roentgenologic methods in detecting left ventricular hypertrophy. The electrocardiographic pattern of left ventricular hypertrophy, or strain, has been recognized for a long time, but specific criteria indicating the point of departure from normal were not established prior to an analysis of some 940 cases carried out by us (10). On the basis of this study, left ventricular hypertrophy may be considered to be present when left axis deviation occurs in association with any of the following changes:

(1) Increase in amplitude of the Q.R.S. complex, best expressed by the sum of R_1 and S_3. Hypertrophy is present if this sum exceeds 2.5 millivolts and is probably present if it is over 2.2 millivolts. The increase in voltage is the earliest electrocardiographic change in hypertrophy.

(2) Any perceptible depression of the S-T segment in lead 1, even of as slight degree as 0.5 mm. (0.05 millivolt).

(3) Lowering of T_1 below 1.0 mm. or further degrees of abnormality of T_1.

The changes in the S-T segment and the T wave may develop in the absence of left axis deviation. The latter is not an invariable or necessarily integral part of the electrocardiographic pattern of left ventricular hypertrophy. The usual occurrence of left axis deviation with left ventricular hypertrophy in hypertension is due largely to predominant obesity, with transverse position of the heart, which in itself causes left axis deviation. In slender subjects with left ventricular hypertrophy, left axis deviation is not so frequently observed.

Employing our criterion, we found, in 100 subjects with advanced hypertensive disease, that evidence of left ventricular hypertrophy on the electrocardiogram was present considerably more often than were roentgenologic changes. Electrocardiographic and roentgen changes do not of necessity parallel each other. While electrocardiographic abnormalities occur relatively more often than roentgenologic changes, not infrequently there may be definite evidence of left ventricular enlargement in the roentgenogram while the electrocardiogram is quite normal. Particularly is this the case where concurrent right ventricular enlargement is present, the opposite electrical effects of these chambers balancing each other.

A typical electrocardiographic pattern occurs in right ventricular hypertrophy, consisting of right axis deviation and S-T segmental and T changes in leads 2 and 3. However, this is not as specific as the left ventricular pattern, as it may be simulated in normal individuals of long narrow build, with vertically placed hearts, and occurs also in emphysema. Auricular hypertrophy may be indicated in the electrocardiogram, too, by tall, wide, and notched P waves, but these changes likewise are not specific, as they may occur in other circumstances. In general, then, the electrocardiogram is most valuable in detecting left ventricular hypertrophy. For the other cardiac chambers roentgenologic methods are unquestionably superior.

The right ventricle does not participate in forming the cardiac contour in the postero-anterior projection, since it forms the anterior surface of the heart. Nevertheless, enlargement of this chamber is indicated indirectly in this position. As the right ventricle increases in size, it displaces the right auricle to the right, causing increased prominence and convexity of the right border. Even more characteristic is a straightening and increased prominence

of the upper left heart border between the aortic arc and the left ventricular segment. This results from elevation and rotation of the pulmonary artery by the enlarged outflow tract or infundibular portion of the right ventricle so that its contour becomes more prominent than the normal pulmonary artery curve. The term "prominent pulmonic conus" is commonly employed to describe these changes. Actually, the conus, or infundibular portion of the right ventricle, appears on the upper left heart border only in advanced cases. When right ventricular hypertrophy is marked, with relatively little dilatation, as in congenital cardiac lesions such as the tetralogy of Fallot, a characteristic change in the left heart border is observed. The apex is elevated by the hypertrophied body of the right ventricle (inflow tract), producing a rounding of the lower left contour (*coeur en sabot*).

The right ventricle is best studied by examination in oblique views. In the right anterior oblique position, a forward bulge of the infundibular portion of the right ventricle (outflow tract) toward the sternum is observed. A rounding and anterior extension of the lower right ventricular border observed in the left anterior oblique position occurs at a somewhat later stage. This is indicative of hypertrophy of the body of the right ventricle (inflow tract).

The left atrium forms the posterior surface of the heart and does not contribute to the cardiac silhouette in the posteroanterior projection except for a small and variable segment of the left auricular appendage above the left ventricular border. The left atrium enlarges posteriorly and to the right, and only in slight degree to the left. Occasionally the enlarged left auricle projects to the left, causing a slight bulge above the left ventricular contour. Ordinarily, however, the filling in and straightening of the "cardiac waist" above the left ventricle which are characteristically observed in mitral valvular disease (the commonest cause of left atrial enlargement) are due chiefly to associated right ventricular enlargement displacing the pulmonary artery, rather than to left atrial enlargement *per se*. Rarely, in cases with marked left atrial enlargement this chamber may project considerably from the upper left heart border.

A much more frequent finding in the presence of marked left atrial enlargement is extension of the left atrium to the right, with projection beyond the border of the right auricle. A double festoon results. The left atrium may in certain cases with free mitral insufficiency become massively dilated, coming to occupy the lower half of the right thoracic cavity.

Oblique views are indispensable to establish the presence of lesser degrees of enlargement of the left atrium. In the left anterior oblique position, the left atrium forms the upper portion of the posterior cardiac border. Normally a space of approximately a finger's breadth is present between the upper border of the left atrium and the left main bronchus. As the atrium enlarges, this space becomes obliterated. Further degrees of enlargement elevate and ultimately compress the bronchus. It must be emphasized that elevation of the left main bronchus is not an early sign of left atrial enlargement. It is preceded by obliteration of the infrabronchial space (7), a sign which has not hitherto received attention.

The right anterior oblique or right lateral position ordinarily gives the earliest indication of left atrial enlargement. The left atrium enlarges posteriorly into the retrocardiac space. This is evident directly on fluoroscopic examination or in the roentgenogram when well marked, but the detection of this change is greatly facilitated by outlining the esophagus with barium. The esophagus pursues a vertical course in the posterior mediastinum directly behind and in apposition with the posterior surface of the heart (left atrium). As the left atrium enlarges, the barium-filled esophagus is indented and displaced posteriorly in the retrocardiac space, beneath the impressions of the left main bronchus and the aortic arch. When marked atrial

enlargement is present, the esophagus is displaced far backward against the anterior border of the vertebrae. Minimal left atrial enlargement is best detected by administering a thick barium paste which adheres to the esophageal mucosa, outlining it for some length of time after swallowing. It is inadvisable to expose roentgenograms during swallowing of a thin barium mixture such as is used in gastro-intestinal study, for the barium bolus can indent the left atrium during deglutition so that lesser degrees of retrodisplacement of the esophagus will escape observation. The esophagus is displaced not only posteriorly but somewhat to the right, which is revealed by rotating the subject into the postero-anterior or antero-posterior position after examination in the right anterior oblique view. Posterior displacement of the esophagus is the earliest and most certain sign of enlargement of the left atrium, and usually antecedes other changes such as obliteration of the infrabronchial space, elevation of the left main bronchus, or straightening of the upper left heart border.

One aspect of left atrial enlargement merits comment. In certain cases with a long-standing free mitral insufficiency, marked enlargement of the left ventricle and tremendous dilatation of the left atrium occur. The left atrium displaces the esophagus posteriorly against the right, coming to form not only the entire right heart border, but in extreme cases occupying the entire lower thoracic cavity. This constitutes a unique clinical syndrome (7). Despite the remarkable enlargement of the heart, which exceeds that seen in any other condition, there is frequently a surprising freedom from symptoms of impaired cardiac reserve, and the patient may continue for years with relatively little limitation of activity. The freedom from pulmonary congestion may be due to the enormously dilated left atrium acting as a reservoir between the heart and lungs. This condition develops most frequently in subjects in the third and fourth decades with a long-standing history of rheumatic heart disease. Auricular fibrillation invariably is present. Occasionally a marked systolic heave may be palpated over the right lower anterior chest due to systolic distention of the enlarged atrium resulting from free mitral regurgitation. The systolic distention of the left atrium can be observed in roentgenkymograms, which also show large amplitude of the left ventricular contractions with very rapid filling in early diastole from the distended left atrium.

The right atrium (auricular portion) forms the entire right heart border. Enlargement results in extension of the right heart border laterally. Prominence of this contour, however, is not specific, since a prominent right heart border may result from enlargement of any of the cardiac chambers, particularly the right ventricle, displacing the right atrium to the right. Enlargement of the right atrium usually occurs as part of generalized cardiac enlargement, almost never as an isolated clinical entity. Enlargement of this chamber is most noteworthy in tricuspid valvular disease.

Extension of the right cardiac contour simulating right atrial enlargement occurs in pericardial effusion. It may be relevant to speak briefly of pericardial effusion, for the problem frequently arises of differentiating pericardial effusion from generalized cardiac enlargement. Since the various clinical features may be inconspicuous, the existence of pericardial effusion, even of appreciable size, may be unsuspected, and its presence may be disclosed inadvertently during routine roentgen examination of the chest. Roentgenologic examination provides the most certain diagnostic evidence, apart from paracentesis, when pericardial effusion of any considerable amount is present.

The roentgen appearance of pericardial effusion frequently is characterized by such terms as bottle-shaped, bag-shaped, or triangular. It should be emphasized, however, that the appearance of pericardial effusion in the roentgenogram is extremely variable. There is no one configuration

typical of a pericardial effusion, as contrasted with enlargement of the heart, all the more since the shape of the enlarged heart shows great variation, depending on the chambers involved. If there is any configuration suggestive of effusion, it is generalized enlargement of the cardiac shadow with loss of the characteristic shape due to obliteration of the normal contours of the chambers and great vessels. No alteration in shape is evident until a large amount of fluid has accumulated, and it is generally accepted that effusion less in amount than 10 to 12 ounces cannot be discerned with any certainty.

Several authors have called attention to a change in the angle at the junction of the right lower heart border and the diaphragm. We have not found this sign to be of any value, since the right cardiophrenic angle, which varies greatly in enlarged hearts in the absence of effusion, may remain either unchanged or become increasingly acute or, conversely, more obtuse.

When the effusion is large, the fluid extends upward, distending the pericardium near its attachment to the great vessels, obliterating the aortic arch and pulmonary artery curves. The shadow of the vascular pedicle becomes foreshortened and broadened. This change in the shape at the base may be accentuated by examining the patient in the recumbent position with the head and chest tilted downward. A marked shift in the shape of the cardiac shadow on rotation from the right to the left lateral recumbent position is a helpful sign, but such shifts must be interpreted with reserve unless marked, since the position and shape of the enlarged heart, too, may change with shift in body position.

A rapid change in size of the cardiac shadow on serial examination is more suggestive of pericardial effusion than the appearance at any one time. Contrary to usual belief, the heart, as revealed by roentgen study, does not as a rule dilate to any considerable degree in heart failure. It is unusual to observe marked changes in the size and shape of the cardiac shadow over a short period of time in any of the commoner types of heart disease. Roentgenologic examination at frequent intervals is therefore an aid in the diagnosis of pericardial effusion when progressive changes in the size of the cardiac shadow can be demonstrated on successive examinations.

In acute pericardial effusion, the restraining influence of the pericardium may cause cardiac tamponade. Signs of obstruction to the circulation play a prominent part in the clinical picture, such as paradoxical pulse, small pulse pressure indicative of diminished cardiac output, and increased venous pressure. In chronic pericardial effusion, however, there may be remarkably little or no interference with the circulation, since the pericardium is gradually distended and its capacity is greatly increased. Clear lung fields, free of any pulmonary congestion, are frequently observed in chronic pericardial effusion. When the heart is markedly enlarged as the result of heart disease, on the other hand, some degree of pulmonary congestion is usually present. Marked enlargement to the right, as seen in massive enlargement of the left atrium and tricuspid valvular disease, may simulate the roentgenologic appearance of pericardial effusion, but these lesions may be clinically differentiated. As a general rule, enlargement of the cardiac shadow considerably to the right in the absence of peripheral and pulmonary congestive changes is a typical finding in pericardial effusion.

Characteristically, pulsations along both heart borders are greatly diminished in the presence of a considerable effusion into the pericardium, but this sign must be interpreted with reserve. The pulsations of the lower heart borders are frequently greatly diminished when the heart is markedly enlarged due to any type of organic heart disease. Study of the pulsations in the left anterior oblique position is of value. Normally vigorous systolic pulsations of large amplitude are observed over the lower

posterior left ventricular border and even in the presence of marked cardiac enlargement the pulsations do not diminish to the same degree as the apical pulsations in the postero-anterior position. Pericardial effusion accumulates early in this region, and in the left anterior oblique position the left ventricular pulsations become obscured as the fluid collects in the inferior pericardial recess. When the effusion is large, the lower posterior cardiac contour may be seen to sag into the diaphragm, indenting the stomach. Inflation of the stomach with an effervescent mixture aids study of the pulsations of the inferior cardiac surface.

The cardiac pulsations are best studied by means of roentgenkymography. While diminution of the cardiac pulsations, as mentioned, is not specific, the disparity between the amplitude of pulsations of the descending aorta, which tends to remain normal, and the greatly diminished amplitude of left ventricular pulsations is suggestive of pericardial effusion.

It has been reported by some that a double density distinguishing the heart shadow within the borders of the effusion can be observed occasionally in cases of pericardial effusion, but the validity of this sign has been denied by most authoritative observers, nor have we ever encountered this finding in a case of pericardial effusion. Holmes (11) investigated this question experimentally by injecting fluid into the pericardial sac of dogs and was not able to discern any difference in radiographic density between the heart and pericardial contents.

Contrast visualization of the heart by means of diodrast offers a method whereby the cardiac chambers may be clearly outlined within the effusion. An overpenetrated roentgenogram exposed two to three seconds after the rapid injection of 30 to 45 c.c. of 70 per cent diodrast visualizes the right auricle, and the outline of this chamber can be clearly demarcated from any surrounding pericardial effusion. Visualization of the other cardiac chambers with diodrast is not as satisfactory as that of the right auricle unless the multiple exposure technic is employed, due to the dilution of the dye in the pulmonary vascular bed, uncertainty as to the speed of the circulation of the diodrast through the lungs to the left side of the heart, and the possibility of exposing the roentgenograms when the heart is contracted and relatively empty, in systole. However, the right auricle can be visualized regularly without difficulty, and the finding of a double contour provides a pathognomonic sign of pericardial effusion.

We have devoted the greater part of this presentation to a discussion of cardiac measurements and to certain phases of cardiac enlargement which have interested us, such as electrocardiographic changes in left ventricular hypertrophy, the lead scale method to replace orthodiascopy, obliteration of the infrabronchial space as a sign of left atrial enlargement, the arc method of determining the diameter of the aorta, diodrast diagnosis of pericardial effusion, and tables and nomograms for transverse diameter and frontal area. I do not wish to leave the impression, however, that the recognition of enlargement is the only important consideration in roentgenologic study of the heart. Time does not permit us to go into detail, but we have already briefly indicated that fluoroscopic study of the individual heart chambers is an invaluable aid in various types of heart disease. Observation of the cardiac pulsations also contributes information, particularly in cardiac infarction, constrictive pericarditis, and pericardial effusion. The cardiac pulsations may be analyzed objectively by means of roentgenkymography, a technic which has proved of value not only in clinical problems but in physiological studies as well, such as determination of cardiac output. One of the really significant advances in cardiac roentgenology in the past few years has been the technic of contrast visualization of the cardiac chambers with diodrast, introduced by Robb and Steinberg (12). The application of the method has been advanced notably with the multiple ex-

posure method (13) and has proved of particular value in the diagnosis of congential cardiac lesions (14).

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Benign Ulceration Within a Duodenal Diverticulum

Report of a Case[1]

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DIVERTICULOSIS of the duodenum is seen frequently enough that the lesion can no longer be called uncommon. On the other hand, benign primary ulceration of the small bowel, except in a Meckel's diverticulum, is still a rarity. The combination of the two lesions, namely, a benign primary ulcer within a duodenal diverticulum, must be a rare condition indeed. Buckstein (1*a*) states that at times a diverticulum may give rise to symptoms as the result of ulceration but cites no specific case. The present writer, in a review of the literature on diverticulosis and primary ulceration of the small bowel, was unable to find a single instance of this character. Although the case being presented has not been proved from the pathologist's point of view, it exhibits the usual radiographic signs of benign ulceration as seen elsewhere in the gastrointestinal tract, both in the acute phase and in interval stages to complete healing. Aside from the fact that the lesion is a rarity, the case is of importance as emphasizing certain facts relative to diagnosis and the clinical significance of such a lesion.

CASE REPORT

N. L. B., a 77-year-old white male, was first seen on Feb. 6, 1945. About fifty-five years earlier he had experienced an attack of right-sided abdominal pain of about ten days' duration, which confined him to bed. In subsequent years he had occasional attacks of mild diarrhea followed by generalized dull abdominal pain of one to two days' duration. These episodes never confined him to bed and usually abated after he had modified his diet to one of a bland nature. He always felt that the ingestion of eggs bore a definite causal relationship to these attacks.

In the spring of 1942 the patient was operated upon for a gangrenous appendix, following which he made an uneventful recovery. In July 1942, while in a hospital in Toronto, Ont., for an eye operation, he had a moderately severe attack of steady epigastric pain following the ingestion of tomato juice. Morphine was necessary to control the pain. In the first week of February 1945, he again experienced a dull, aching epigastric pain, more to the left of the mid-line, occasionally radiating to the precordial area. There was no pain down either arm. Biliary calculi were excluded by cholecystography.

On the night of March 12, 1945, the patient had the most severe attack experienced to date. There was a sudden onset of severe, steady epigastric pain, characterized as heavy and aching in nature. Again the use of morphine became necessary. There was no pain over the precordium or radiating to either arm. The blood pressure was 145/90, and the temperature remained normal. The white blood cell count was normal, with 76 per cent neutrophils. Previous electrocardiograms, and one subsequent to this attack, showed essentially normal tracings, with no evidence of coronary disease.

On the morning following this attack, a gastrointestinal examination was made. The esophagus, stomach, and duodenal bulb appeared normal, although there was generalized epigastric tenderness which could not be precisely located over any one area. Not seen on the fluoroscope, but observed on the films, was a large, walnut-sized diverticulum arising from the inner aspect of the junction of the third and fourth portions of the duodenum. In the right lateral wall of the diverticulum was an ulcer crater about 4 mm. in diameter, with some induration and edema at its base. At the end of four hours there was a minimal amount of barium clinging to the mucosa of the antral portion of the stomach, the duodenal bulb remained completely filled, and a small amount of the opaque medium was retained in the ulcer crater. The diverticulum, however, had completely emptied itself. The impression at this time was benign ulceration within a duodenal diverticulum.

The patient was placed on a strict ulcer regimen and re-examined thirteen days later. The ulcer crater was again demonstrated, both on the roentgenogram and on fluoroscopy, which was carried out in the horizontal as well as the upright position. Some tenderness was still present, and at this time could be definitely located over the diverticulum and not over the duodenal bulb. There did not appear to be any induration at the base of the ulcer at this examination, however. A four-hour film showed no evidence of retained barium in either the ulcer

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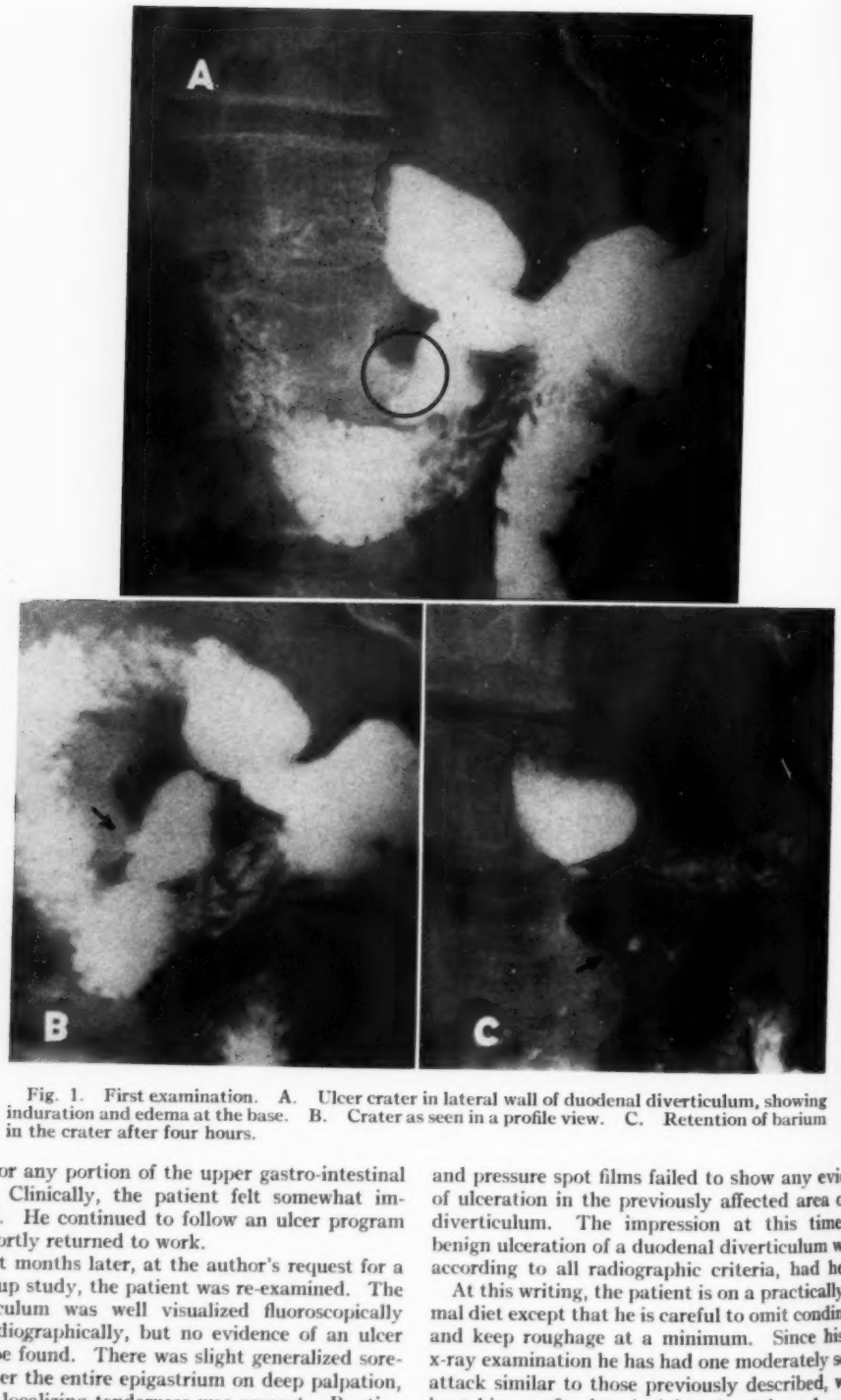

Fig. 1. First examination. A. Ulcer crater in lateral wall of duodenal diverticulum, showing induration and edema at the base. B. Crater as seen in a profile view. C. Retention of barium in the crater after four hours.

crater or any portion of the upper gastro-intestinal tract. Clinically, the patient felt somewhat improved. He continued to follow an ulcer program and shortly returned to work.

Eight months later, at the author's request for a follow-up study, the patient was re-examined. The diverticulum was well visualized fluoroscopically and radiographically, but no evidence of an ulcer could be found. There was slight generalized soreness over the entire epigastrium on deep palpation, but no localizing tenderness was present. Routine and pressure spot films failed to show any evidence of ulceration in the previously affected area of the diverticulum. The impression at this time was benign ulceration of a duodenal diverticulum which, according to all radiographic criteria, had healed.

At this writing, the patient is on a practically normal diet except that he is careful to omit condiments and keep roughage at a minimum. Since his last x-ray examination he has had one moderately severe attack similar to those previously described, which kept him confined to bed for about four days. It

is of interest to note that he is wont to have a bit of food shortly before retiring and that all of the more severe attacks have occurred about one-half hour after he had gone to bed.

PATHOGENESIS

The origin of duodenal diverticula is still a controversial issue that need not be entered into here. There seem to be valid arguments for either an acquired or a congenital origin. The question of chief interest in the present case is what changes take place, and under what conditions, to produce ulceration in the diverticulum.

The outstanding factor in the production of peptic ulcer is the proteolytic action of the gastric secretion upon an area of mucous membrane whose vitality has already been lowered, as by interference with its blood supply or direct trauma. That this action is related to the acidity of the gastric juices is strongly suggested by the anatomical distribution of duodenal ulcers, but such a factor can be of little significance in the production of ulcers beyond the second portion of the duodenum.

It is conceivable that small islets of aberrant gastric mucosa, whose glands function in a manner identical with those located normally in the stomach, might play a role, elaborating digestive ferments in normal or excessive amounts. Gastric heteroplasia is said by Ehrenpreis (2) to occur in about 12 per cent of Meckel's diverticula, and in such cases peptic ulcers have frequently been found (3). Superficial heterotopia of gastric glands in the small intestine is, however, of sufficient rarity (4, 5) to eliminate it as a likely cause of ulceration in a duodenal diverticulum. There is, furthermore, no record of the association of such ectopic tissue with a primary ulcer of either the ileum or jejunum (1*b*).

In a series of 47 primary jejunal ulcers collected from the literature by Ebeling (6), the majority were found to be located opposite the attachment of the mesentery, an area where the caliber of the vessels encircling the bowel is greatly reduced. This observation would seem to favor the theory of circulatory impairment as a primary cause of this type of ulcer. In view of the structure of diverticula, it does not seem unreasonable that similar areas of vascular insufficiency might occur within their walls, especially if the diverticula are of considerable size. Such vascular impairment would furnish a predisposing factor, while retention of food—more especially, large quantities of roughage—would act as an effective irritant. The normal reparative process in lesions thus provoked in the mucosa would be hampered and the tendency to ulcer formation enhanced.

DISCUSSION

It is well known that diverticula arising from the third and fourth portions of the duodenum often fail to fill with the opaque medium with the patient in an upright position, and are therefore unobserved during fluoroscopy if this position only is used. In the case recorded here, at the first examination, fluoroscopic study was limited to the upright position, following which the usual prone and oblique films were obtained in the horizontal position. Although the entire duodenal sweep was seen on the fluoroscopic screen, the diverticulum was not visualized. There was definite epigastric tenderness, but this could not be precisely localized to the region of the duodenal bulb. When the wet films were viewed, the diverticulum, containing the ulcer crater, was observed for the first time.

Failure to demonstrate on routine films a lesion which was seen fluoroscopically is not uncommon. This only emphasizes the fact that we cannot depend upon films alone for information about diverticula, but must subject them to the same scrutiny with which other parts of the alimentary tract are examined. The use of palpation is essential where this procedure is anatomically possible. Fortunately, in the case reported, the lesion was visible on the routine films (Fig. 1).

In the second examination (Fig. 2, A), fluoroscopy was done in both the upright and horizontal positions, and tenderness,

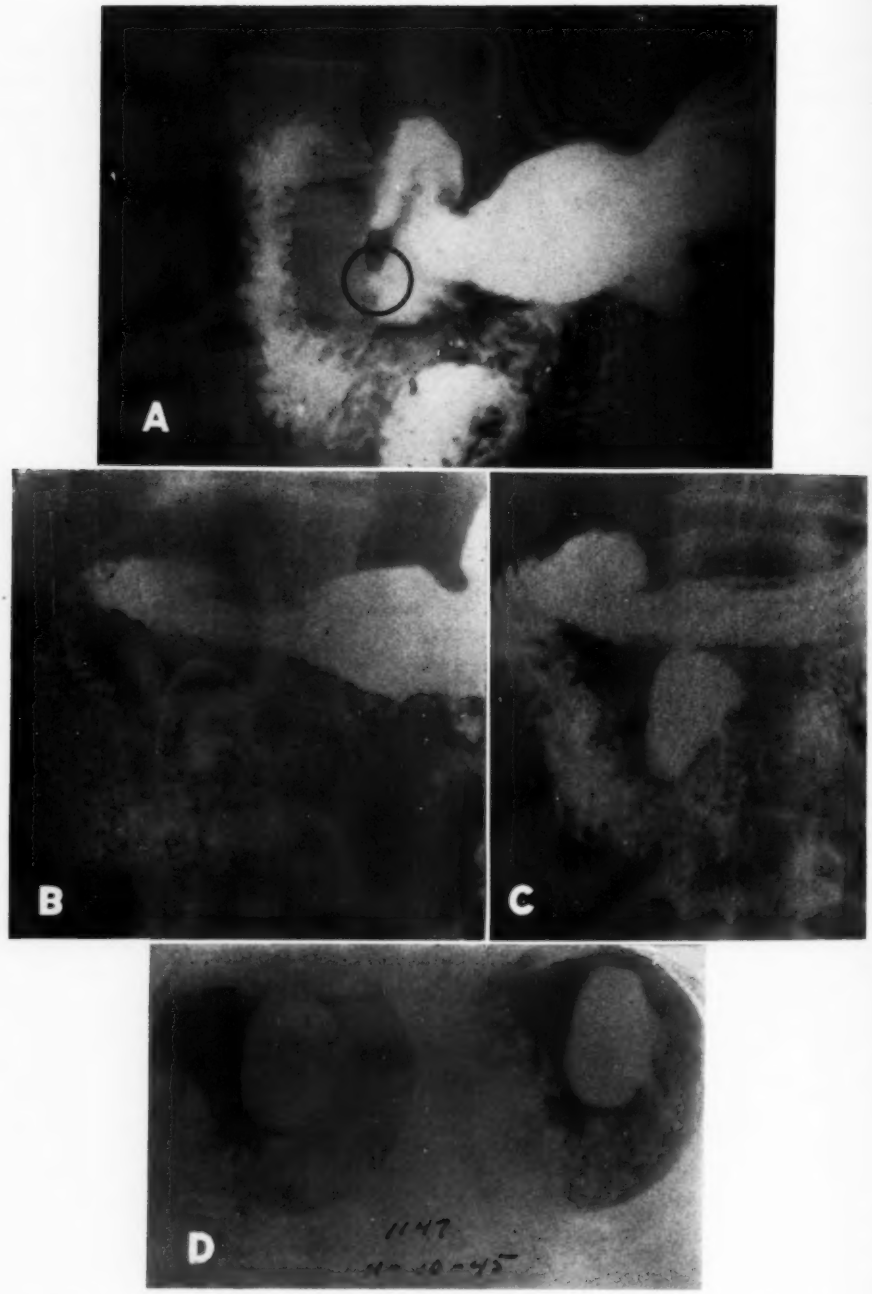

Fig. 2. Second and third examinations. A. Crater still present thirteen days later, but induration and edema have disappeared. B, C, D. Ulcer apparently healed, eight months later. No sign of a crater.

which was less at this time, was definitely located over the ulcer crater. At this examination the induration and edema at the margins of the ulcer, as seen in Fig. 1, A, were no longer present, although the crater was still demonstrable. These findings, the diminution in tenderness, and absence of retention in the crater after four hours were interpreted as indicating a lessening of the inflammatory reaction and a tendency toward healing. A follow-up examination approximately eight months later showed no sign of an ulcer crater on conventional films (Figs. 2, B and C) or spot films for which pressure was used (Fig. 2, D). Although there was some generalized soreness in the epigastrium, no localizing tenderness could be elicited over the diverticulum. The author believes that these findings are satisfactory radiological evidence that the lesion has healed and prove its benignancy.

From the clinician's point of view, this case establishes another possible source of intestinal bleeding. Not uncommonly patients are referred to the roentgenologist for a gastro-intestinal study because of a secondary anemia and the presence of occult blood in the stool. There are always a few such cases in which the examination reveals no intrinsic disease, possibly because the lesion is too minute. Some examinations may prove entirely negative except for an isolated duodenal diverticulum. Because such a lesion is prone to be a silent one, little significance is attached to it. The fact remains, however, that if an ulcer can develop within such a defect, it is capable of bleeding. If the lesion is small and remains hidden by barium, it can be readily understood how it may defy detection.

SUMMARY

1. A case of benign ulceration within a duodenal diverticulum is reported.

2. The pathogenesis of the lesion is discussed.

3. The use of palpation with the patient in a horizontal position is stressed as a vital part of radiological examination of the gastro-intestinal tract.

4. The clinical significance of such a lesion is mentioned.

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Reactions of Connective Tissues After Protracted Fractionated Irradiation of Laryngeal Carcinoma[1]

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WITH INCREASING experience in protracted fractionated irradiation, it has been thought that one of the advantages of this method is that the connective stroma remains functionally and also morphologically almost unaltered, and that this is responsible to a large extent for the improved radiation effects. Clinical observations, however, of the fibrin reaction of the mucous membrane in the early stages of protracted fractionated irradiation, and of the atrophy, sclerosis, edema, and necrosis of connective tissue in later stages, are contradictory to this view. Thus it seems justified to describe microscopic findings on the connective tissue observed in the larynx one to ten months after protracted fractionated irradiation.

At the time of fibrinous epithelitis, the connective tissue is definitely altered. Absence or irregularity of nuclear staining, large nuclei, vacuolization of the cytoplasm, and fatty degeneration are exhibited microscopically. In this stage, various amounts of fibrin are present in the subepithelial and deep connective-tissue layers (Fig. 1). The changes are less advanced than those in the epithelial cells, which are completely disintegrated at the time of the fibrinous radiomucositis.

One to two months after irradiation, the most frequent change in the connective tissue is a fibrinoid necrosis. This is best demonstrable with Weigert fibrin stains. With ordinary methods of staining, it is not recognizable as such. In some cases, one may later observe transition of areas of fibrinoid necrosis into colliquation, and spotty disintegration of the involved structures. On the other hand, a transformation into hyaline sclerotic scar tissue is often seen. In the latter cases, the entire lamina propria of the larynx becomes atrophic to such an extent that the glands seem to be located immediately below the regenerated epithelium, due to the atrophy of connective layers (Fig. 2). The elastic fibers lie close to each other in such conditions.

Necrotic areas of the connective tissue are located chiefly in the internal layer, near the lumen. This suggests that, in addition to the direct effects of radiation, there may be secondary accidents precipitating retrogressive connective-tissue changes. The almost constant finding of fusiform bacilli and of gram-positive cocci in disintegrated connective tissue indicates that secondary infections progressing from the lumen may play an important role in the development of such changes. The boundaries of the necrotic areas often display characteristic retrogressive nuclear changes and also a mild lymphoid cellular reaction. After more intense irradiation, lymphoid cells may be absent, the boundaries of the necrotic areas being marked only by a zone of nuclei in all stages of karyorrhexis, pyknosis, and karyolysis.

Areas of the larynx previously occupied by the tumor are replaced by hyaline scar tissue (Fig. 3), consisting of homogeneous intercellular collagen with very few cells, blood vessels, and elastic fibers. The scar tissue is located mostly below the epithelial layers and extends in the shape of a funnel into the deep parts of the larynx. The regenerated epithelium covering the scar is flat.

Changes in the blood vessels are most marked nearest the lumen. They include capillary ectasia and dilatation of small arteries and veins. Some blood vessels

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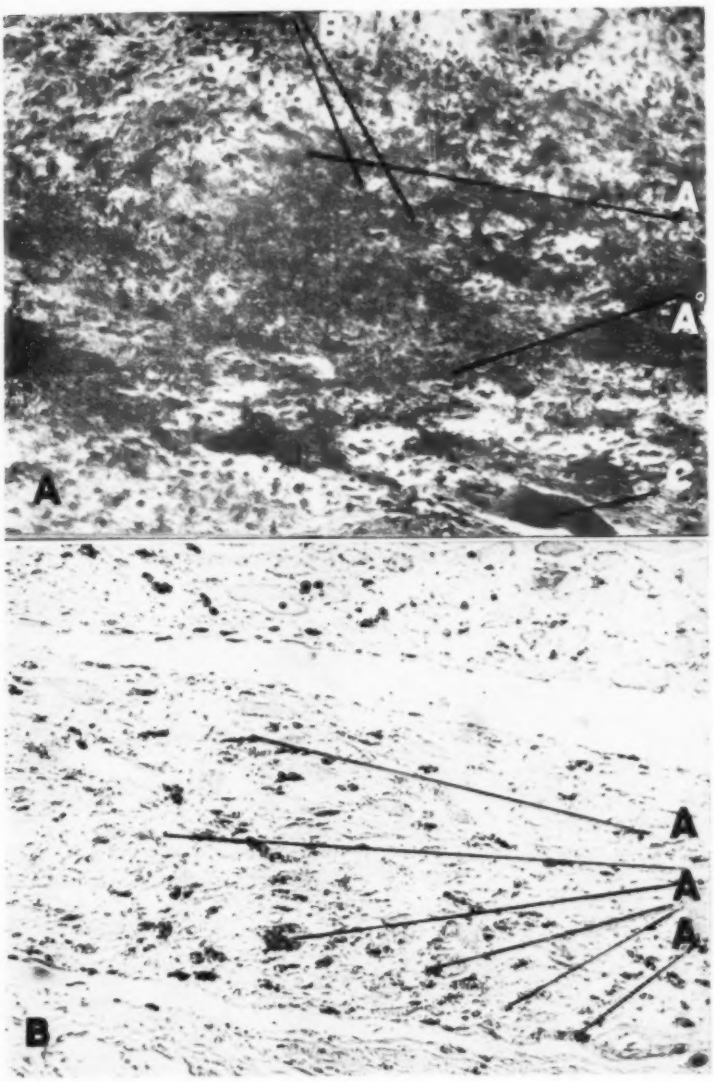

Fig. 1. A. Fibrin exudate (A) in deep layers of connective tissue at time of fibrinous reaction. Note large nuclei (B), absence of nuclear staining, and muscle fibers in Zenker's degeneration (C). Hematoxylin-eosin. × 150.
B. Fatty degeneration of connective-tissue cells at time of fibrinous reaction. A. Fat droplets. Hematoxylin-Sudan III, gelatin embedding. × 70.

are completely obliterated, especially in areas of atrophy and sclerosis of connective tissue. It is remarkable that veins are more extensively changed than arteries. This may be a possible explanation of the ubiquitous development of edema. It is found in all possible locations in the larynx, often where inflammatory and circulatory edema do not occur, and occasionally even in deep connective tissue between muscle bundles. Microscopically, one sees wide tissue spaces often filled with a coagulated eosinophilic (albuminous) material. In some instances, capillary blood vessels are markedly widened (Fig. 4) in the environment of edema. Large

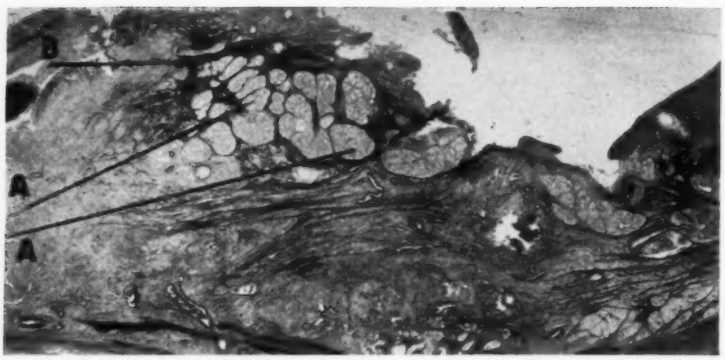

Fig. 2. Atrophy of subepithelial connective tissue indicated by proximity of large laryngeal glands (A) and of elastic tissue (B). Weigert's elastin-lithium carmine stain. × 50.

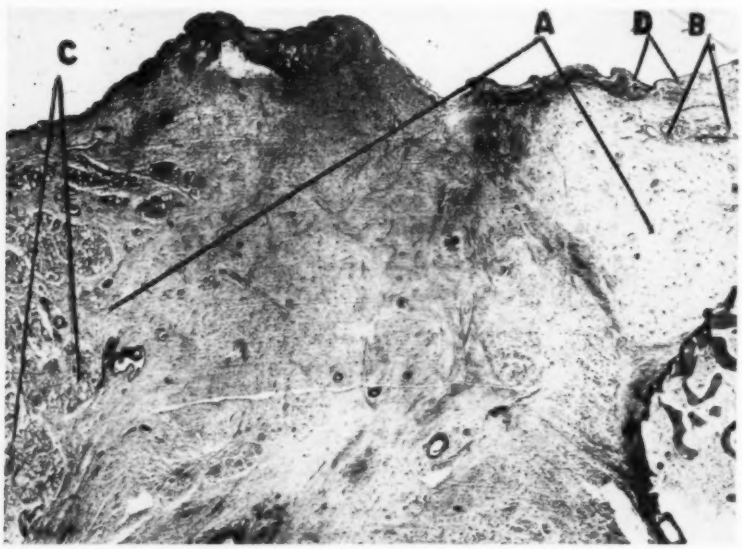

Fig. 3. Area occupied by tumor tissue before irradiation, filled with hyaline-sclerotic connective tissue (A); atrophy of glands within hyaline scars (B); normal appearing glandular tissue (C). Note atrophy of epithelium above scar tissue (D). Hematoxylin-eosin. × 50.

vacuoles are present in the protoplasm of connective-tissue cells and many of them are isolated and surrounded by larger tissue spaces.

Muscles, fat tissue, and nerves show various abnormalities. Atrophy of muscle fibers with marked increase of connective tissue between them and also Zenker's degeneration are common findings near the lumen. Large multinucleated giant cells are found, indicating a tendency of muscles to regenerate. Small isolated groups of fat cells surrounded by an increased amount of connective fibers and atrophy of the cytoplasm are considered to be effects of radiation. In such cell groups, sudanophilia is decreased and the cytoplasm reveals honeycomb structures.

Advanced changes in nervous tissues are occasionally noticed. Stains of frozen sections prepared after the method of Spielmeyer show irregular myelin sheaths

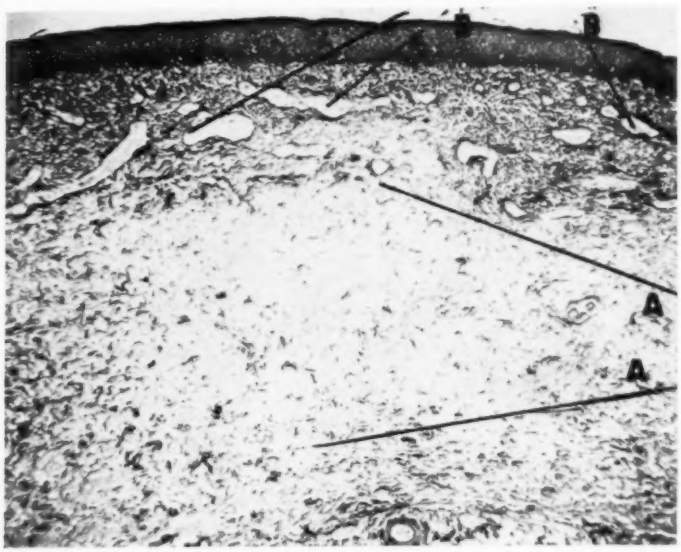

Fig. 4. Submucous edema with dissociation of connective fibers (A); widening of capillary blood vessels (B). Hematoxylin-eosin. × 150.

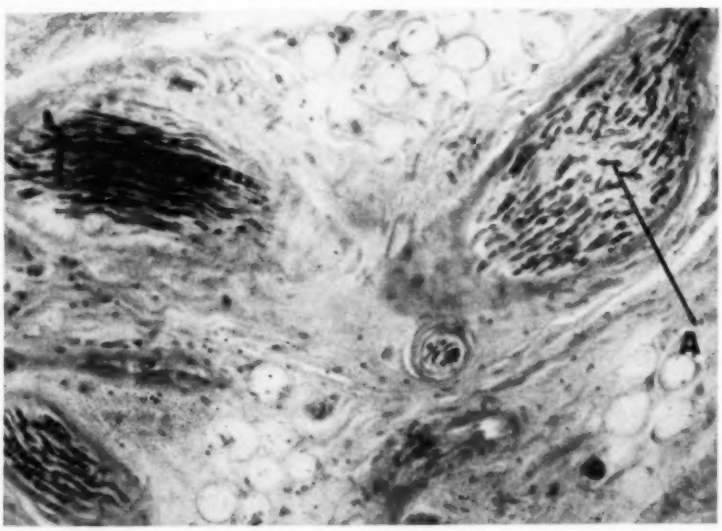

Fig. 5. Disintegration of myelinic sheaths. Characteristic myelin droplets (A). Spielmeyer stain. × 250.

with disintegration of the myelin and characteristic precipitation of lipoid droplets (Fig. 5). Elastic fibers often appear in irregular groups; frequently they disintegrate completely. They are also changed in elastic cartilages. In areas of atrophy, thinning of the subepithelial connective tissue—condensation of the elastic fibers—is shown without much actual loss of the latter. Scars replacing disintegrating tumor tissue do not contain elastic fibers.

The perichondrium (Fig. 6) is characterized by a selective radiosensitivity.

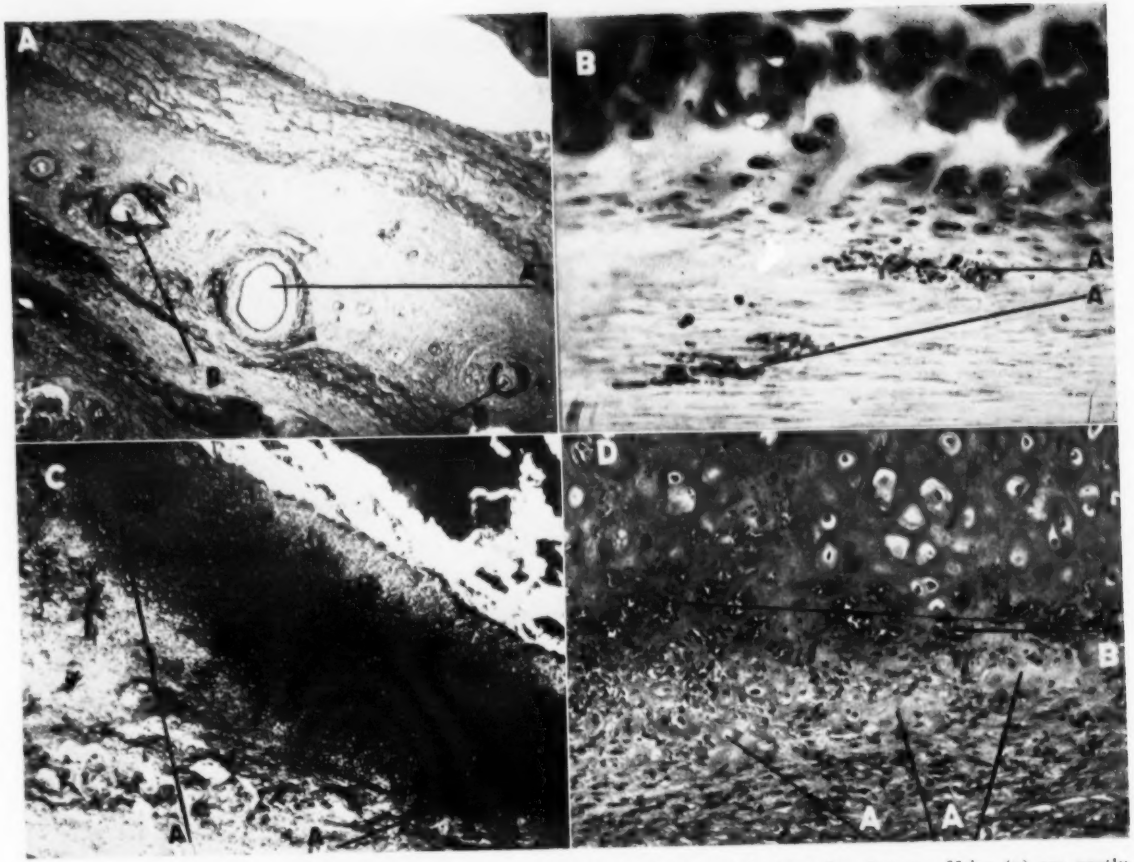

Fig. 6. A. Blood-vessel changes in perichondrium. Middle-sized artery (A) shows free lumen. Veins (B) are partly obliterated by productive endophlebitis. Retracted cartilage in right upper portion of picture. Weigert's elastin stain. × 70. B. Fat droplets in perichondrium (A). Hematoxylin-Sudan III. × 500. C. Fibrin exudate in perichondrium (A) at time of fibrinous reaction. Retracted cartilage in right upper corner of picture. Hematoxylin-eosin. × 70. D. Inflammatory cell reaction in hyaline perichondrium (A). Lymphocytes (B) infiltrate the superficial layers of the cartilage itself. Hematoxylin-eosin. × 250.

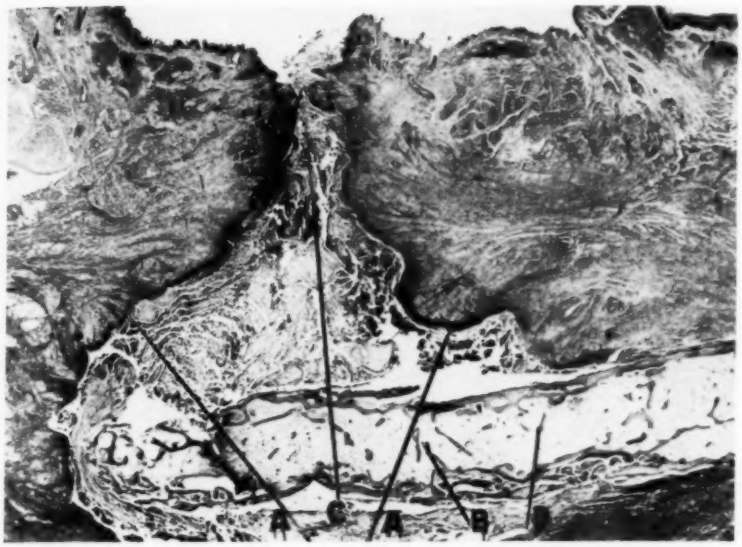

Fig. 7. Large abscess cavity (A) in surrounding of ossified cartilage (B), communicating by fistulous duct (C) with inner surface of larynx. Inflammatory cells are almost completely absent in wall of cavity. Hematoxylin-eosin. × 50.

This is probably due to its specific vascularization. The blood vessels around the cartilage form an almost closed system of arteries and veins which have very few collaterals communicating with the vessels of adjacent structures (Schumacher). At the time of the fibrinous reaction, isolated fibrin exudate can occasionally be seen in the perichondrium. Later, obliterative vascular changes become evident. These are often associated with fatty degeneration of the perichondrium itself. The degenerated tissue seems to be more susceptible to infections than adjacent structures. Consequently, a selective infiltration of the perichondrium by inflammatory cells is a common finding in early post-irradiation conditions. These changes are followed later by more or less extensive tissue disintegration. Abscess cavities are formed around the cartilage or bone tissue. They may break through to the inner surface of the larynx, producing fistulous ducts or larger necrotic areas (Fig. 7).

As a rule, the system of bone and periosteum shows a greater resistance to irradiation than the cartilage and perichondrium. Retrogressive changes developing in the perichondrium and adjacent tissues often stop in the area of transition. Bone marrow, if present, is usually atrophic; in one case (6,500 r), however, examined six months after the last irradiation, functioning hematopoietic parenchyma was exhibited.

Inflammatory reactions are remarkably reduced. Often, cellular reactions are absent in the environment of necrotic or necrobiotic areas. In many instances, superficial ulcerations or deep perichondritic abscesses show disintegration of the connective tissue without cellular reactions in their surroundings. In certain cases, it appears that the resisting power of the connective tissue against the progress of bacterial invasion is almost entirely absent. Acute retrogressive changes progress without a noticeable sign of tissue defense. The few inflammatory cells found are mostly small lymphocytes. At times, a few plasma cells and also polymorphonuclears are present around deeper layers of necrotic areas.

In order to study inflammatory reactions of irradiated connective tissue after protracted fractionated irradiation, the follow-

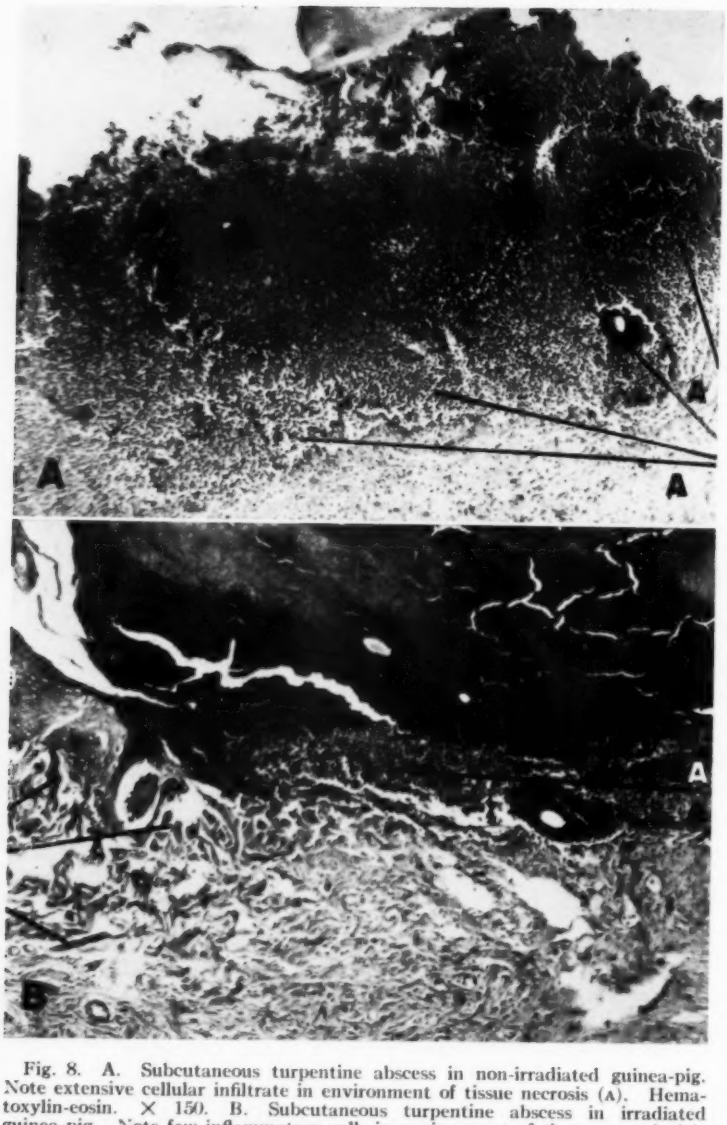

Fig. 8. A. Subcutaneous turpentine abscess in non-irradiated guinea-pig. Note extensive cellular infiltrate in environment of tissue necrosis (A). Hematoxylin-eosin. × 150. B. Subcutaneous turpentine abscess in irradiated guinea-pig. Note few inflammatory cells in environment of tissue necrosis (A). Connective tissue partly hyalinized. Hematoxylin-eosin. × 150.

ing series of experiments was performed. The right inguinal areas of three guinea-pigs of equal weight were irradiated, the physical factors being as follows: field 2×2 cm.; skin-target distance, 30 cm.; skin dose, 4,500 r; 180 kv.; Thoraeus filter; 15 r per min., 150 r daily. On the first day after the last irradiation, 0.02 cm. of turpentine was injected subcutaneously into the irradiated areas. On the same day, the same amount of turpentine was injected into corresponding areas in three non-irradiated guinea-pigs of the same weight. Four days later, sterile abscesses appeared in both series of animals at the injection sites (Fig. 8).

Microscopically, the abscesses in the irradiated animals revealed a marked edema

and fibrin exudate in the vicinity of tissue necrosis; remarkably few inflammatory cells, mainly lymphocytes, were present. The deep layers of subcutaneous connective tissue were dense and somewhat sclerotic. In control animals there was a broad layer of polymorphonuclear leukocytes with serofibrinous exudate in the vicinity of the abscess, and no connective-tissue changes were displayed. Abscesses in irradiated animals healed in seventeen days, those of control animals eight days after injection.

COMMENTS

Microscopic studies show that, contrary to general belief, there are profound and extensive early and late changes in the connective tissue after protracted fractionated irradiation of the larynx. It seems that the changes are primarily and principally the same as those which are known to appear after simple irradiation, not protracted. The basic difference is that, with a similar x-ray dose without fractionation, the connective tissue changes are more advanced and are irreversible, resulting in total destruction of the irradiated areas. The alterations in the connective structures after protracted fractionated irradiation are reversible; however, the microscopic appearance and function of newly formed connective tissue with regard to inflammatory reactions are different from those in unirradiated tissue. This can be proved in animal experiments.

Examination of a large number of microscopic slides reveals that after a balanced course of irradiation, without demonstrable interference of bacterial infections, the characteristic condition of regenerated connective tissue is that of a hyaline sclerosis. This is associated with a diffuse atrophy of the areas involved. Cancer tissue surrounded by hyaline sclerotic connective tissue exhibits advanced disintegration, while that surrounded by loose connective-tissue layers shows various degrees of retrogressive change. It does not disintegrate as completely as if it were surrounded by hyaline scars. Not only cancer cells enclosed in areas of sclerotic atrophy, but also laryngeal glands, muscles, and fat tissue become atrophic. Blood vessels are often obliterated under such conditions.

During the past years, it has become the general opinion that the trophic effects of irradiation on the connective tissue are to a large extent responsible for the disintegration of the tumor cells. It has been pointed out that certain forms of cancer might be destroyed by trophic influences of the connective tissues alone. Maximal effect can be expected if the loose normal connective tissue becomes transformed into hyaline structures. This transformation is evidently more successfully induced by fractionation of the dose for a long period of time than by expeditive methods of irradiation. There is no doubt that the hyaline sclerotic connective tissue with its few cells and blood vessels is not only morphologically but also functionally an entirely different tissue from the lamellar, loose connective layers of the membrana propria of the larynx. The structural and probably also the functional changes develop after regeneration of the connective tissue following irradiation damage. Since these newly formed connective structures are under the influence of radiation during retrogression as well as during regeneration, they must be more radioresistant than the normal connective tissue (Regaud); otherwise, their regeneration during irradiation could not occur.

There are indications that the beginning of the hyaline sclerosis of the connective tissue is coincidental with the resorption of the fibrin exudate from intercellular spaces. In our series of examinations, this was indicated in one case only, but in four other cases it could be demonstrated that there is a certain *relation between the extent and intensity of the clinical fibrinous radiomucositis and extent of development of the hyaline sclerotic connective tissue.* A complete series of examination materials were not at the writer's disposal, so that the question of whether the development of a hyaline sclerosis is in some way indicated by the differences in quality and quantity of the fibrinous radiomucositis, could not be defi-

nitely decided in the present studies. If, however, clinical experience shows that there exists a relationship between the effects of irradiation upon the tumor on the one side and the appearance and intensity of the fibrin exudate on the other, it would be worth while investigating whether or not the differences in the fibrin reaction indicate that a more or less extensive hyaline metamorphosis of the connective tissue is to be expected and, in connection with it, a more or less extensive retrogression of the tumor.

SUMMARY

Three stages may be observed in the connective-tissue changes following protracted fractionated irradiation of the larynx:

The *first* is a bionegative, retrogressive period characterized by exudation of fibrin, loss of nuclear staining, and frequent changes in the microchemical reaction of subepithelial collagenous fibers. This period is coincidental with the fibrinous radiomucositis and disintegration of the epithelial cells of the mucous membrane.

The *second* period might be called a biopositive regenerative period. Connective tissue fills out the spaces remaining after disintegration of the tumor. The retrogressively changed fibrinoid necrotic collagen of the lamina propria is replaced by hyaline sclerotic layers. Myogenous giant cells indicate the regenerative tendencies of these tissues. Inflammatory reactions of the regenerated connective tissue are markedly reduced as a specific effect of radiation on this structure. This has been shown not only on human tissues but also in animal experiments. Damaged endothelium of blood vessels reacts with connective-tissue proliferation, causing obliterative changes.

A *third*, retrogressive, period may be expected in cases which have been improperly irradiated or in which the individual sensitivity of the connective tissue is higher than average. In such cases, the newly formed connective tissue becomes necrotic, the mucous membrane shows ulcerations, and secondary bacterial infections develop and progress into deep layers of the irradiated larynx.

The histologic changes following fractionated protracted irradiation differ from those present after single or expeditive methods of irradiation. Retrogressive and regenerative conditions develop under the influence of a continuous flow of the radiant energy. It is therefore reasonable to assume that such connective tissue becomes more resistant to the irradiation and probably will not disintegrate if increasing doses are delivered in the course of protracted fractionated irradiation.

The probable relationship between fibrin exudation, development of fibrinoid necrosis, and its replacement by hyaline sclerotic connective tissue are discussed in detail. The result of this is a profound change of the general nutritive conditions of the larynx, mainly in areas near the lumen. The development of perichondritis and edema is also influenced by vascular changes.

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The Biological Significance of Fibrinous Radiomucositis of the Larynx[1]

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SINCE THE FIRST description of fibrinous radiomucositis of the oropharynx and larynx, the significance of this phenomenon has often been in the foreground of discussions but has never been definitely evaluated. Investigators have been inclined to believe that this reaction may be considered as a clinical test indicating radiobiological changes in the irradiated tumor. The time of appearance and the extent of fibrinous exudate formation are widely used as an indicator for the amount and distribution of radiation in the therapy of tumors of the oropharynx, nasopharynx, and larynx.

It has been pointed out that the appearance of an extensive and confluent radiomucositis indicates that the dose necessary to destroy tumor cells has been reached. On the other hand, the necessity of the production of a confluent radiomucositis in order to achieve a favorable therapeutic result has been doubted. Borak emphasized that if the applied dose does not induce radiomucositis, or provokes only a mild degree thereof, regression of the tumor will be temporary and incomplete. As a rule, in such cases recurrence may be expected in about a year and permanent cure is the exception.

I have studied a number of larynges (autopsy specimens) microscopically at or near the height of fibrinous radiomucositis. The epithelium is gone. The fibrin lies on what I take to be the old membrana propria. It also dips into the ducts of mucous glands, the acini of which are distended by basophilic material (retained secretion). Large amounts of fibrin are present in the subepithelial connective tissue and also in laryngeal muscles and in the perichondrium. This is a constant finding in the presence of clinically observed fibrinous mucositis and had persisted in one case for two months after the last irradiation. In cases in which fibrinous radiomucositis did not occur, only small amounts of fibrin or fibrinoid were noted in the connective tissue (4 specimens).

Since standard irradiation technic was used, we must assume that the variation in degree of fibrinous exudate formation was due to constitutional differences prevailing in the tissues of the larynx itself. The larynx seems to react to irradiation in the same manner as it does to bacterial, chemical, or thermal influences. These, too, often induce the development of strong fibrinous pseudomembranes. At times, however, this reaction fails to occur, despite exposure to the same pathological stimuli.

Microscopic examination conclusively shows that superficial and deep fibrinous exudation is not a reaction of tumor cells or tumor structures, as has been assumed. It is a reaction of connective tissues and blood vessels. As Lubarsch pointed out, development of fibrinous membranes always follows necrosis of epithelial cells. Hirschfeld believes, however, that the first step in the course of development of fibrinous membranes is fibrin exudate formation. In his observations, fibrin accumulated below the epithelium, and this became necrotic secondarily. The fibrin then coagulated, covering the defect caused by the epithelial necrosis. At the same time, the subepithelial connective-tissue spaces became saturated by masses of exudate, which again coagulated in the presence of necrotic cell structures. In such cases the collagenous fibers exhibited a positive biochemical fibrin reaction. Ac-

[1] From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. The second of a series of four papers accepted for publication in June 1946.

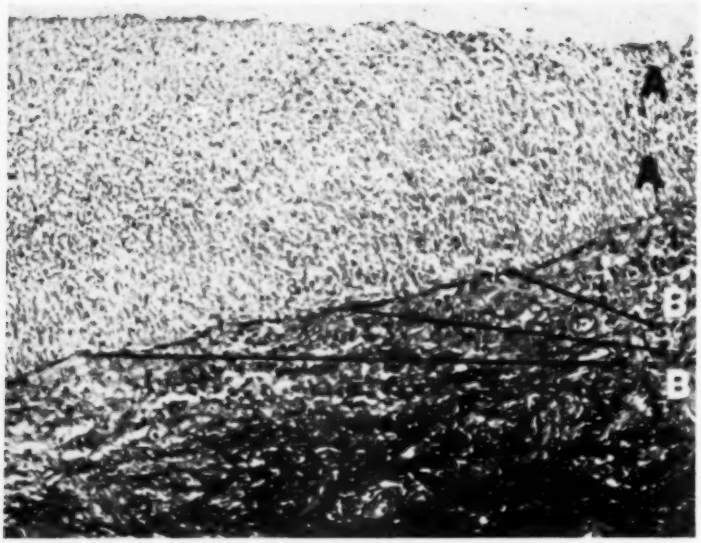

Fig. 1. A 60-year-old man presented a flat, ulcerated cancer on the left parietal portion of the epiglottis (squamous-cell carcinoma, G ade 2). Total tissue dose 7,760 r; 4.3 r/min.; two fields, each 6 × 5 cm.; Thoraeus filter; 200 kv. Clinically, radioepithelitis was marked, starting on the thirteenth day and still present on the twenty-eighth day, when the patient suddenly died.

Gross local findings: Flat ulcerations on vocal cords. Right side of epiglottis shrunken. Inside of larynx and both piriform sinuses covered with greenish-gray fibrinous membranes easily identified with those seen clinically during irradiation. Area previously involved by tumor now filled with fibrous scar tissue.

Microscopic findings: Epithelial cells destroyed. Thick fibrinous membrane (A) above membrana propria (B), replacing epithelial tissue. Significantly, very few leukocytes were present in and below the fibrinous membrane. Van Gieson stain. × 250.

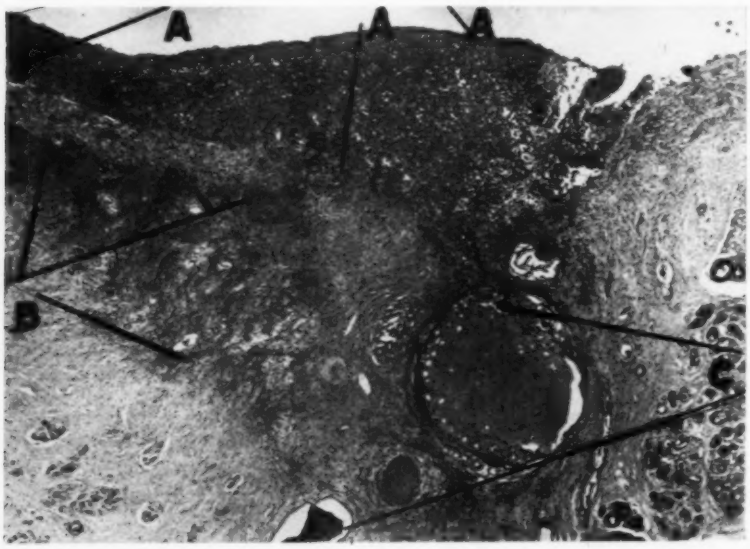

Fig. 2. Same case as Fig. 1. Superficial fibrin masses (A) dip into ducts of mucous glands. Large amounts of fibrin are present in the subepithelial connective tissue (B). Ducts are dilated (C). Hematoxylin-eosin. × 70.

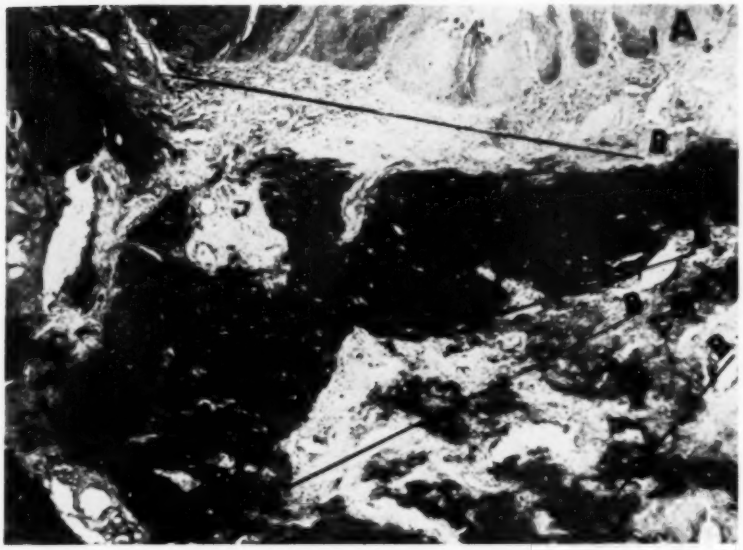

Fig. 3. A 71-year-old man had cancer of the left vocal cord and left aryepiglottic area, extending below the cord (squamous-cell cancer, Grade 2). Total tissue dose 5,340 r; 4.3 r/min.; Thoraeus filter; 200 kv. Clinically, a mild fibrinous reaction started on the twentieth day and disappeared on the twenty-eighth.

Microscopic examination six and a half months after the last day of irradiation showed epithelium regenerated, thick epidermoid (A); subepithelial tissue retrogressively changed, exhibiting a strong fibrin reaction (B). Fibrin stain according to Weigert. × 150.

cording to Marchand, this explains the development of so-called fibrinoid necrosis.

Clinical observation of irradiated patients gives the impression, however, that radionecrosis of the epithelium always precedes the development of fibrinous membranes. If fractionated irradiation is used, the disintegration of epithelial cells depends exclusively upon the dose received. In the absence of fibrinous reaction, epithelial radionecrosis may be recognized clinically by the presence of deep local hyperemia with loss of surface glossiness.

The fibrin is not produced by epithelial cells but by the reaction of the connective tissue and capillary blood vessels under the epithelium or after they are denuded of epithelium. Thus, it is the mirror of the connective-tissue response to irradiation. Even if fibrinous membranes are located above tumor tissue, they do not come from the tumor cells but from the supporting interstitium between the cells. Epithelial cells, either normal or cancerous, are unable to produce fibrin. Whenever differences are observed in the time of appearance, intensity, and location of fibrinous radiomucositis, they are indicative of variations in reaction of connective and vascular tissue and not of variations in direct radiosensitivity of tumor cells.

If, despite these facts, a definite clinical relationship has been established between the properties of the fibrinous membrane and the reactions of the tumor to irradiation, the only explanation can be that this relationship is based mainly on reaction of the connective and not of epithelial structures. It must also be emphasized that there is no microscopic evidence for the general belief that at the time fibrinous radiomucositis appears, the connective tissue is unchanged. Fibrin has already appeared in the subepithelial connective tissue when the epithelium first begins to disappear.

Before summarizing the significance of

radiomucositis, the following considerations must be reviewed:

1. Doses of radiation sufficient to destroy the epithelium always produce fibrinous mucositis provided that there is a constitutional capacity of the connective tissue of the larynx to produce fibrin in the actual case.

2. Radionecrosis of epithelial tissue may be present in the absence of fibrinous radiomucositis.

3. Strong radiomucositis is not a sign of increased sensitivity of the epithelium or the cancer. It merely indicates increased constitutional ability of laryngeal tissue in a particular case to produce fibrinous exudate.

4. Delay or absence of radiomucositis with standard dosage does not necessarily mean that the cancer is not radiosensitive. It signifies inability or a low degree of ability of the connective tissue to produce fibrin.

5. The early appearance of radiomucositis, however, is a sign of early disintegration of the epithelial cells and an early reaction of the connective tissue to radiant energy. Such reaction holds promise that cure will be attained.

6. These relations are the same, whether the radiomucositis is localized above the tumor or in more distant areas of the oropharynx.

Clinical experience shows that if fibrinous radiomucositis appears early or intensively, retrogression is more rapid and complete than in cases in which this reaction is weak or delayed. It also seems that within certain limits there is a more definite interrelation between the intensity of radiomucositis and disappearance of the tumor than between the amount of radiation applied and the curative effect of the treatment. Occasionally, pronounced radiomucositis appears after the application of a relatively small dose. Consequently, if clinical experience proves a relationship between shrinkage of the tumor and the properties of radiomucositis, in view of the connective-vascular nature of this reaction, we must conclude the following:

1. Connective-vascular tissue participates notably in the complex of reactions connected with tumor retrogression provoked by irradiation.

2. Radiomucositis and its properties are indicative of the degree and extent of connective-tissue reaction.

3. The more marked and earlier the connective-tissue reaction, the more it contributes to the success of radiation therapy.

4. Delay or absence of connective-tissue reaction is associated with a clinically less favorable effect of irradiation.

Consequently, if we evaluate the clinical aspects of radiation therapy of laryngeal carcinomas from the properties of radiomucositis in a particular case, we estimate the capacity of the connective tissue to participate favorably in radiobiological reactions, rather than the direct radiosensitivity of the cancer cells. It appears, also, that any physical variation in treatment which has as its purpose the promotion of vital reactions of the connective tissue, in addition to the primary destruction of tumor cells, promises optimal clinical results.

The interaction between tumor and connective tissue as regards the significance of fibrinous reaction is not yet definitely established. It appears probable, however, that connective structures displaying strong fibrinous reactions are more likely to be transformed in the course of irradiation into a hyaline atrophic and fibrosclerotic condition than connective tissues which do not exhibit this property. The important role of nutritive influences of fibrosclerotic structures in retrogression of epithelial neoplasms is, however, an established fact.

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Latex Cap for Radon Ointment Treatment[1]

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IN THE FALL OF 1943 the section of Oro-Facial Prosthesis, College of Dentistry, University of California, was asked by Dr. B. V. A. Low-Beer, of the Department of Radiology, University of California Medical School, to solve the problem of fabricating latex caps that would fit over any surface of the body to confine air-tight applications of radon ointment.

A technic was developed and latex caps were made to meet the following prerequisites:

(*a*) Periphery of cap must be in perfect apposition to the tissue, regardless of anatomical contour.
(*b*) There must be no contact between the cap and the lesion proper.
(*c*) The cap must be securely held in place, the periphery sealed air-tight with liquid adhesive instead of adhesive tape.
(*d*) The cap must be light, semiflexible, and sterilizable.
(*e*) The cap must have tissue tolerance.

The method previously used was the placement of a piece of rubber dam over the lesion, the periphery being sealed with adhesive tape. The disadvantages of this method were:

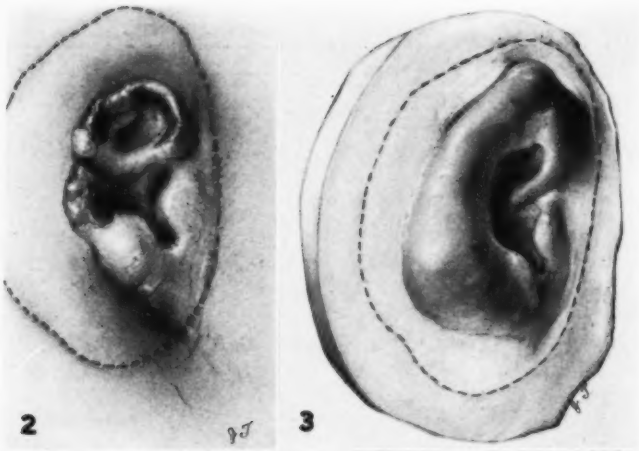
(*a*) The frequent inability to seal the periphery airtight.
(*b*) Irritation and annoyance from the use of adhesive tape.
(*c*) Pressure on the lesion.
(*d*) Inability to accurately follow anatomical configuration.

To meet the predetermined requirements and avoid the difficulties formerly met, the most obvious approach is to have an accurate impression of the area under consideration. Proceeding with this in mind, the following steps are taken.

Fig. 1. Radiation ulcer, right ear.

(*a*) Place the patient in a comfortable position on a table or a gurney with the area of which the impression is required in a horizontal position. The area of the lesion to be covered by the cap is determined and outlined with indelible pencil by the physician. An accurate impression is taken with a suitable material, such as alginate, colloid, or plaster of paris, and extended at least 1.0 cm. beyond the outline.
(*b*) Pour a positive model from the impression in stone or plaster of paris. This cast with the peripheral margin transferred will be a perfect replica of the area under

[1] From the Section of Oro-Facial Prosthesis, College of Dentistry, University of California, San Francisco, Calif. Accepted for publication in April 1946.



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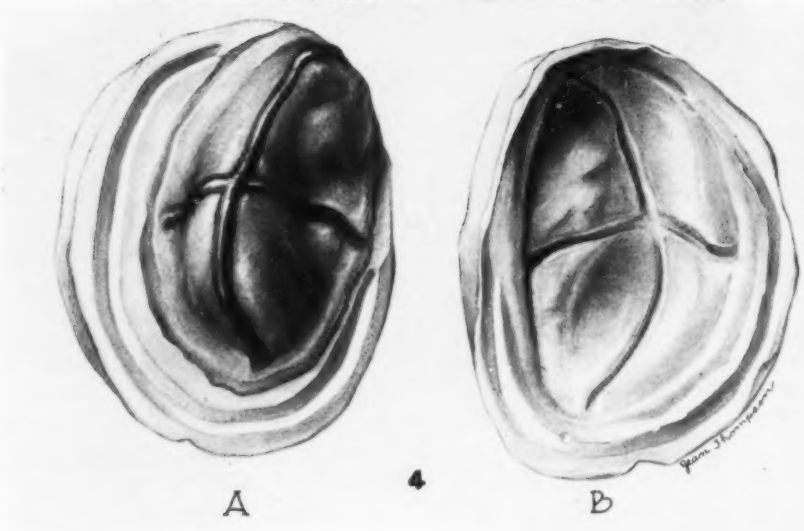

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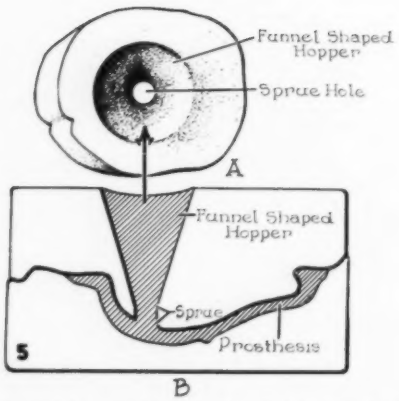

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Fig. 2. Original model. Fig. 3. Original model modified to give a negative relief, so there will be no contact between ulcer and latex cap. Fig. 4. Wax pattern formed on modified model (note re-inforcing ribs). B. Negative poured in plaster of paris on A. Fig. 5. A. Plan view of Fig. 4 A, showing hopper and sprue hole after wax is eliminated. B. Cross section of Fig. 4, with A and B assembled. Fig. 6. External view of finished cap.

consideration. The cast, or model, is checked for accuracy, and any irregularities corrected. (Fig. 2.)

(*c*) Modify the model so as to have a space of 3.0 to 8.0 mm. between the finished latex cap and the lesion proper. This is accomplished by carefully placing several sheets of base plate wax over the area to be relieved. (Fig. 3.)

(*d*) Make an impression of this model with the wax onlay as if it were the patient, and pour a new cast. This modified model relieves pressure over the lesion.

(*e*) Adapt base plate wax over the modified model, this time to be the pattern for the latex cap. The thickness of the cap and reinforcement will vary from 2.0 to 8.0 mm., depending upon the size and the shape of the finished prosthesis. Seal the periphery of this wax pattern to the modified model. (Fig. 4, A.)

(*f*) Box in the model with the wax pattern with ash metal or wax and pour a second half in plaster or stone. (Fig. 4, B.)

(*g*) Separate the halves and eliminate the wax, drill a sprue hole, and cut out a funnel-shaped hopper around the drilled hole, using the point nearest the model as the apex. (Fig. 5, A.)

(*h*) Clean and dry and reassemble the halves, holding them in place by adhesive tape or C clamps. Pour the liquid latex into the funnel-shaped hopper, vibrate to eliminate all air bubbles; place over a radiator or in a hot air oven to cure for forty-eight hours. (Fig. 5, B.)

(*i*) Separate the halves after the latex is cured. Cut the cap from the sprue, trim up, wash in soap and water, and thoroughly dry. The finished latex cap is now ready for application on the patient. (Fig. 6.)

Fig. 7. Finished latex cap secured in place on patient.

After the lesion is treated with radon ointment, the periphery and flange of the latex cap on the tissue side is covered with a liquid adhesive such as J & J, gum mastic, or Duco cement. The cap is now settled into place and held securely until the cement has set. The patient is dismissed until the next treatment. After each treatment, the latex cap is removed, cleaned up, and made ready for as many cementations as needed. (Fig. 7.)

SUMMARY

A process has been developed for the construction and application of a custom-made latex cap with a periphery capable of being sealed air-tight around a predetermined area, without pressure on the lesion. The cap is capable of being cleaned and sterilized for as many subsequent treatments as necessary and affords a minimum of discomfort and embarrassment to the patient.

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REFERENCE

LOW-BEER, B. V. A., AND STONE, ROBERT S.: Treatment of Late Post-Irradiation Ulcers with Radon Ointment. Radiology **46:** 149–158, February 1946.

Retroperitoneal Perforation of the Duodenum

Report of a Case[1]

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A DISCUSSION OF retroperitoneal perforations, with a report of two cases, was published from this department in December 1944 (Jacobs, Culver, and Koenig). Since that time, a third case, diagnosed by roentgen examination and subsequently proved by surgical exploration, has been studied. A report of this third case is made to demonstrate further the validity of the x-ray findings which were discussed in the earlier article.

CASE REPORT

A 60-year-old obese Italian female was admitted to the hospital about 8:00 P.M., Oct. 5, 1945, complaining of nausea, vomiting, and severe right upper abdominal pain. She gave a history of abdominal distress, heartburn, and nausea for the past twenty years, with acute episodes once or twice each year. She had had a very severe attack about seven years previously, at which time she was in bed for three weeks and required morphine for relief of right upper quadrant pain. Indigestion had been worse than usual for two weeks prior to admission.

The present attack began two days before admission, with nausea, vomiting, and epigastric distention. The patient took both castor oil and enemata several times but obtained no relief of symptoms. About 5:00 A.M., on the day of admission, she was awakened by severe abdominal distress and a feeling of distention. She again took castor oil and an enema with no relief. She vomited at noon and slight temporary relief of symptoms ensued. At 5:00 P.M., there occurred a severe attack of right upper quadrant pain, which was still present when the patient entered the hospital.

On admission, the temperature was 100.2°, pulse 100, respirations 30, blood pressure 120/60. The abdomen was distended, with marked tenderness over the entire upper part. The tenderness was most severe in the epigastrium and right upper quadrant. No peristalsis was heard. Râles and decreased breath sounds were present throughout the bases of both lungs.

Blood findings were as follows: red cells 3,970,000; hemoglobin 90 per cent; white cells 20,800 (81 per cent polymorphonuclear cells with marked left shift); icteric index 5–10; bilirubin (van den Bergh reaction) 0.35 mg. per 100 c.c.; glucose 190 mg. per 100 c.c.; urea nitrogen 18 mg. per 100 c.c.; serum amylase 32. Urinalysis showed albumin 2 plus and glucose 4 plus.

On a plain film made on the night of admission the stomach did not appear to be greatly dilated, but the outline of the greater curvature seemed to lie low in the abdomen. A streak of gas extended along the left crus of the diaphragm and for a short distance along the medial portion of the left leaf. The distribution of the gas appeared to be retroperitoneal.

Further roentgen studies the next morning revealed a greatly distended stomach filled with fluid and gas. This was proved by instilling a small amount of barium through the decompression tube. The distended stomach depressed the transverse colon and a long fluid level was demonstrable with the patient in the right decubitus position. The retroperitoneal gas noted in the left upper abdomen on the previous night extended down over the superior pole of the left kidney.

From the roentgenographic findings it was concluded that the patient had a lesion at or near the pylorus, on the duodenal side, which had produced pyloric obstruction and had perforated retroperitoneally, resulting in the retroperitoneal distribution of air described above.

The patient's condition was unchanged the day following admission. The temperature remained elevated, the abdomen was still distended, and abdominal pain persisted. Treatment was conservative, with gastric decompression and morphine for relief of pain.

On the third day, the findings were essentially the same. On the fourth day, the patient was definitely worse. Her temperature was 103°; her lips were cyanotic, and râles were heard in the bases of both lungs. Gross blood was present in material from the gastric drainage. Roentgenograms taken on this day showed some lessening of gastric distention, with some barium remaining in the stomach after forty-eight hours. More gas was present in the colon and small intestine than on previous examinations. The diaphragm was elevated bilaterally, with moderate compression atelectasis at both lung bases. The air over the superior pole

[1] From the Department of Roentgenology, Buffalo General Hospital, Buffalo, N. Y. Accepted for publication in March 1946.

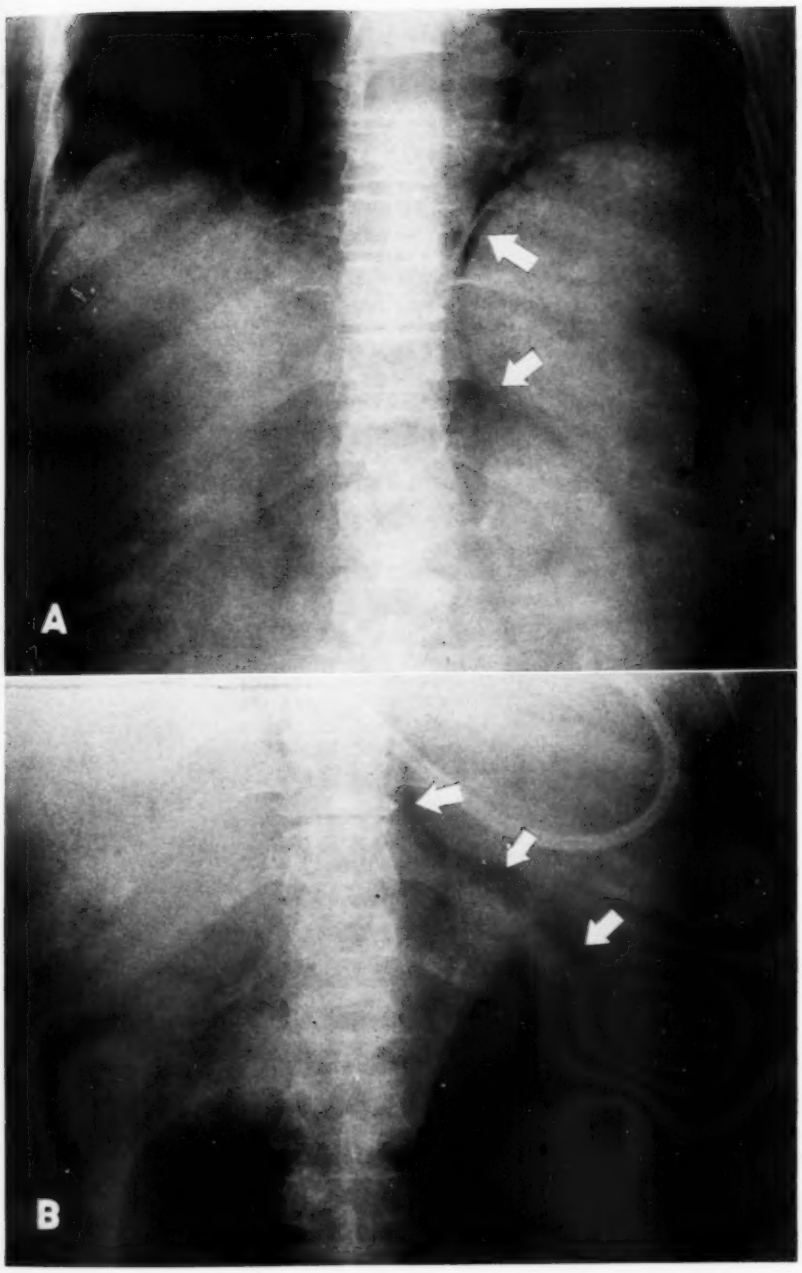

Fig. 1. A. Supine film of the upper abdomen made on the evening of admission (Oct. 5, 1945). Arrows point to the air extending along the crus of the left hemidiaphragm and between the peritoneum and the muscle layer of the diaphragm.

B. Supine film of the upper abdomen made on the morning following the day of admission, showing extension of the gas down over the superior pole of the left kidney.

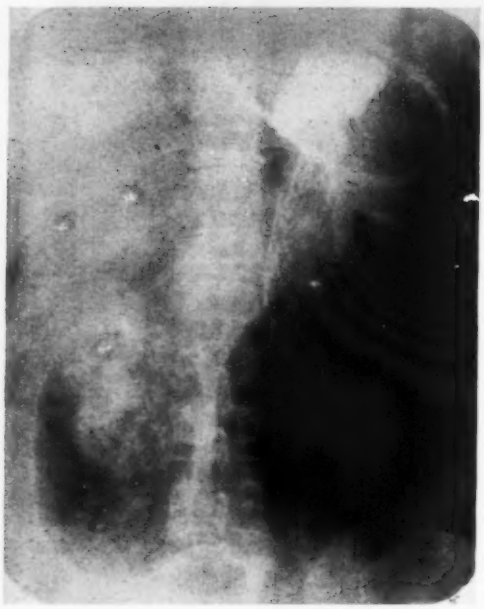

Fig. 2. Film of the abdomen made the same morning as that reproduced in Fig. 1, B. A small amount of barium has been instilled through the decompression tube to outline the markedly dilated stomach.

of the left kidney and under the left diaphragm was still present but appeared to be diminished.

The condition remained about the same for the next seven days. The patient was treated conservatively with penicillin, gastric decompression, and sedation. Her temperature remained elevated, but pain and tenderness subsided, and the abdomen became somewhat less distended. Physical signs persisted in the bases of both lungs.

X-ray examination on Oct. 17 showed the gas bubble in the stomach to be of normal size. Oral cholecystography revealed a non-functioning gallbladder. Further study of the stomach and duodenum, on Oct. 19, showed a duodenal cap which was markedly deformed, with an ulcer crater the size of a match head, in the mid-posterior wall. The deformity was sufficient to give the impression of an inflammatory mass surrounding the cap, probably secondary to a perforation. There was a small diverticulum off the medial aspect of the upper part of the second portion of the duodenum. At the end of four hours, the stomach was practically empty.

The patient continued to show abdominal distention, constipation, and daily spiking of temperature up to 102°. The surgical service, which had clung to a diagnosis of gallbladder disease with complications throughout most of the period of hospitalization, made a final diagnosis (Oct. 20) of perforated ulcer of the posterior wall of the duodenum, with secondary subdiaphragmatic abscess.

On Oct. 25, the abdomen was explored through an upper transverse incision. There were many fibrinous adhesions in the right upper quadrant involving the gallbladder, transverse colon, duodenum, and liver edge. The gallbladder had a thickened wall and contained several stones but was not involved in a recent acute process. The first portion of the duodenum was inflamed and indurated and was believed to be the site of a recent complicated ulcer. No attempt was made to break up adhesions about the duodenum for further exploration.

Upon separating the fibrinous adhesions between the right lobe of the liver and the parietal peritoneum, an abscess cavity was entered which lay between the convex surface of the right lobe of the liver and the diaphragm. About two ounces of serous fluid and many large plaques of lymph escaped. No pus was obtained. The abdomen was closed with a drain in the abscess cavity.

The postoperative course was smooth. Cultures from the abscess were sterile. The patient improved steadily and was discharged with no complaints on Nov. 17, 1945. During her hospital stay, it was discovered that she had a mild diabetes mellitus, which was well controlled by diet.

DISCUSSION

In our original article we presented two cases of retroperitoneal perforation of the duodenum due to blunt trauma to the back. This third case seemed particularly interesting because it was due to an ulcer of the posterior duodenal wall. The distribution of retroperitoneal air was strikingly similar to that noted in one of the cases previously presented, as can readily be seen in the illustrations. This strengthens our previous contention that retroperitoneal perforations can often be recognized by x-ray studies if the roentgenologist is aware of their manifestations on abdominal films.

In this particular case it was possible to make a roentgen diagnosis relatively soon after an acute abdominal episode, in spite of contrary clinical data. Such cases certainly afford a strong argument for more careful and intelligent interpretation of plain films of the abdomen.

CONCLUSIONS

1. A case of retroperitoneal perforation of the duodenum complicating an ulcer of the posterior wall of the duodenum has been presented.

2. Distribution of the extravasated air

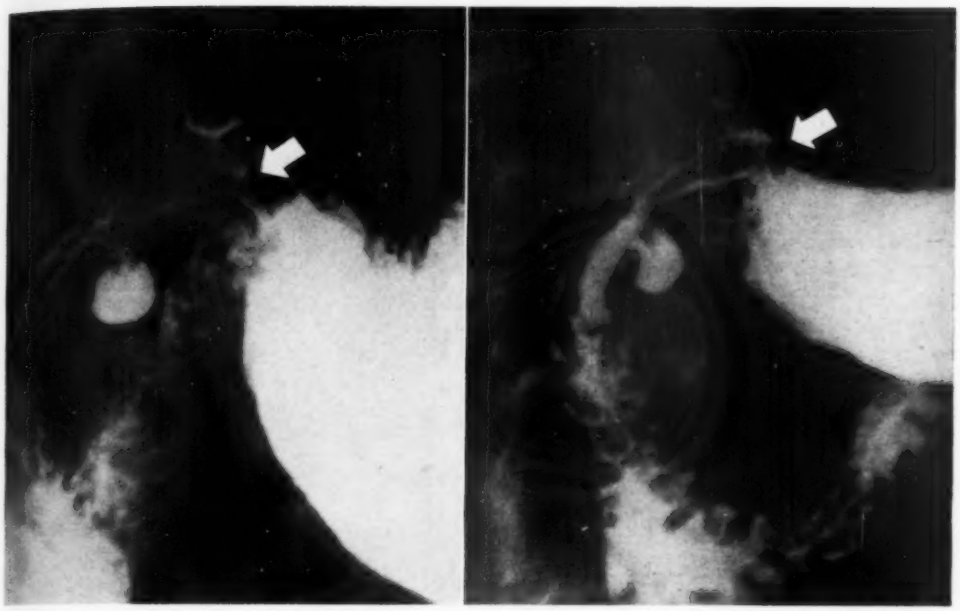

Fig. 3. Films of the duodenum made Oct. 19, 1945, prone and right anterior oblique projections, showing the duodenal deformity with mucosa pulling in toward the area of ulceration in the posterior wall. The small diverticulum off the second portion of the duodenum is also well visualized.

as seen in the roentgenograms has been described.

3. This case is presented only as an added incentive for a more diligent search of plain films in acute abdominal episodes. A previous article considers the entire problem of retroperitoneal perforations.

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Carcinoma of the Transverse Colon in a Fifteen-Year-Old Boy

Case Report with Short Summary of the Literature[1]

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CARCINOMA OF the colon in youth is a rare condition. On the basis of the cases reported, the prognosis appears practically hopeless. If, however, the fact that cancer in youth can and does occur were to be stressed through the recording of all such cases, it is believed that earlier diagnosis might be established, which should in turn improve the outlook.

About 45 per cent of all the various types of cancer occur in the gastro-intestinal tract (1). Of this number, approximately 11 per cent are in the large intestine (2). Malignant tumors in youth have been variously estimated as accounting for 1 to 4 per cent of all malignant neoplastic diseases (3, 4). Thirty-two cases of carcinoma of the large intestine in patients fifteen years of age or under were reported up to 1941 (5–18). In that year Pennell (19) reviewed the literature and added another case to the list. Laird (20), also in 1941, listed 3 cases (21, 22, 23) not quoted by Pennell and added a case of his own. The case presented here is thus the 38th to be reported.

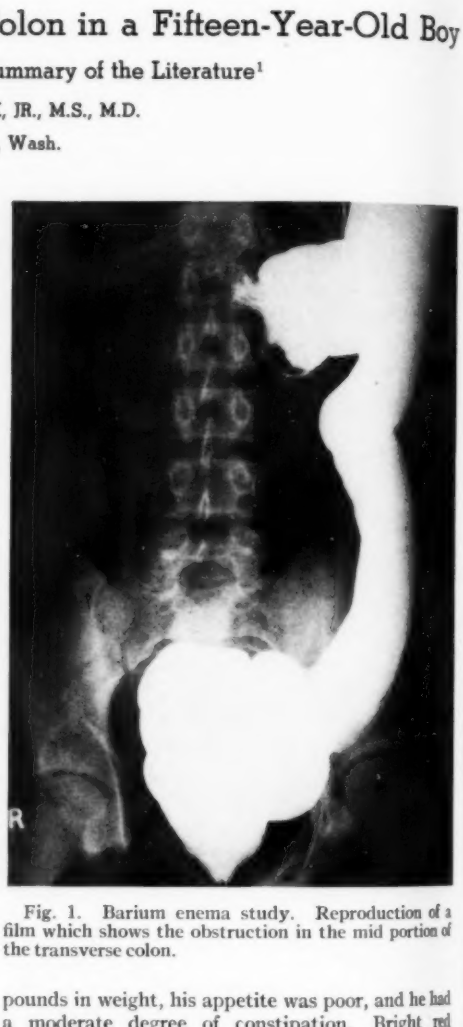

Fig. 1. Barium enema study. Reproduction of a film which shows the obstruction in the mid portion of the transverse colon.

CASE REPORT

J. D. A., a white boy aged 15 years, was brought to Harper Hospital (Detroit) on March 8, 1945, by ambulance, the chief complaint being "stomach cramps" of three weeks' duration. He had previously had a number of similar attacks of abdominal cramps, the first occurring in 1943, two years before admission, at which time the pains lasted about one to two minutes and recurred every fifteen to twenty minutes over a period of twenty-four hours. There had been no nausea, vomiting, diarrhea, constipation, bloody or tarry stools, associated with the pain. Beginning in August 1944, the cramps became more frequent and more severe until the middle of February 1945, when the pain was intense and the patient vomited about once every twenty-four hours. During the three weeks prior to admission to the hospital, he had lost 15 pounds in weight, his appetite was poor, and he had a moderate degree of constipation. Bright red blood was noted in the stool on a single occasion, following an enema.

The earlier history and family history were noncontributory. The only positive physical findings were in the abdomen, where there was exquisite tenderness to light palpation over the course of the transverse and descending colon. There was no rigidity, no masses were palpable, and the liver, spleen, and kidneys could not be felt.

Examination of the blood on admission revealed a slight leukocytosis, with a white blood count of 11,400 (stab cells 33 per cent; segmented cells 41 per cent; lymphocytes 16 per cent; monocytes 8 per cent; eosinophils 1 per cent). The red blood cell count was 4,680,000, and hemoglobin 93 per cent. A roent-

[1] From the Department of Roentgenology, Harper Hospital, Detroit, Mich. Accepted for publication in December 1945.

genographic gastro-intestinal study done previous to hospital admission showed "deformity of the second and third parts of the duodenum and the mid portion of the transverse colon, with complete obstruction in the mid transverse colon and retrograde filling of the bowel with barium. The changes described above have all the characteristics of a neoplasm involving the transverse colon and the adjacent structures, with some evidence of an intrinsic lesion in the colon, though this is extremely unusual in a patient of this age, and one should consider the possibility of a retroperitoneal neoplasm with infiltration of the abdominal structures as described above."

A flat plate of the abdomen was taken upon admission. "A considerable amount of barium was present in the cecum and ascending colon, while only a small amount remained in the pelvic sigmoid and in the region of the ampulla of the rectum." The clinical impression was that of a subacute intestinal obstruction of unknown etiology, possibly malignant, and the patient was given supportive therapy in the form of intravenous fluids, for two days prior to laparotomy. Three 30-c.c. doses of a 5 per cent sodium sulfadiazine solution were given at eight-hour intervals on the day preceding operation.

At operation a very large malignant lesion of the transverse colon was found; the proximal colon was dilated to about twice its normal size, while the distal section was somewhat collapsed because of the obstruction. In the mesentery, extending approximately 2 inches from the site of the original lesion, were several enlarged nodes, which were removed. A classical Mikulicz type of operation was done, with removal of 3 to 4 inches of bowel on either side of the lesion.

Gross pathologic examination of the specimen revealed a 7 cm. slightly raised, pinkish-gray, annular growth which markedly constricted the bowel lumen. The central portion of the tumor was ulcerated, and the entire wall of the colon about the lesion appeared to be infiltrated.

Microscopic Diagnosis: "Advanced adenocarcinoma of the signet-ring type, undergoing colloid degeneration." There was no apparent involvement of the lymph nodes examined.

The *postoperative course* was uneventful, the colostomy was eventually closed satisfactorily, and the patient is doing well after nine months' time.

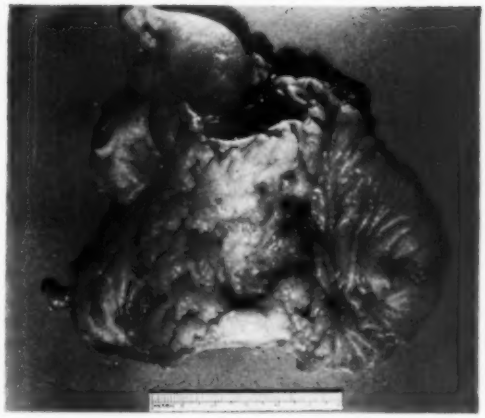

Fig. 2. Gross specimen. Section of colon removed at operation, showing the carcinomatous lesion.

COMMENT

There is great variance in the literature concerning the relative incidence of carcinoma in the different sections of the colon (6, 24, 25). Comparing the figures given by Korte *et al.* (24) concerning cancer of the colon in adults with the collected series of 38 cases in youth, it is found (see Table I) that, in general, the percentage of lesions occurring at various sites is about the same. This is in agreement with the observations of Laird (20) and Phifer (26).

TABLE I: RELATIVE INCIDENCE OF CARCINOMA IN DIFFERENT PARTS OF THE LARGE INTESTINE IN YOUNG PERSONS (UNDER SIXTEEN) AND ADULTS

	Young Persons	Adults*
	Cases	Cases
Cecum	8 (21%)	47 (16%)
Colon	16 (42%)	126 (43%)
Right side	5 (13%)	41 (14%)
Left side	7 (18%)	41 (14%)
Transverse	4 (11%)	44 (15%)
Sigmoid	14 (37%)	124 (41%)
TOTAL	38 (100%)	297 (100%)

* From the literature.

Pathologically, it has been noted in the adult that the fungating, soft, friable, medullary type of carcinoma is more common in the proximal half of the colon, while the scirrhotic, napkin-ring type of neoplasm develops in the distal portion. In this series of 38 cases in youth, most of the carcinomas occurring in the transverse and distal half of the colon were of the "constricting type," thus conforming to the general rule.

The theory that most carcinomas of the large bowel originate in polyps is interesting (6). The actual incidence of malignant transformation in polyps is not known; it is given roughly as from 40 per cent (27) to 60 per cent (28). Of the young patients

coming to autopsy there is a fair percentage with polyposis, with evidence of malignant degeneration found on microscopic examination. However, of the 38 cases of carcinoma of the colon discussed here, only one showed doubtful evidence of polyposis, that of Pfeiffer and Wood (29), in which a "fibroma with adenocarcinomatous change" was found.

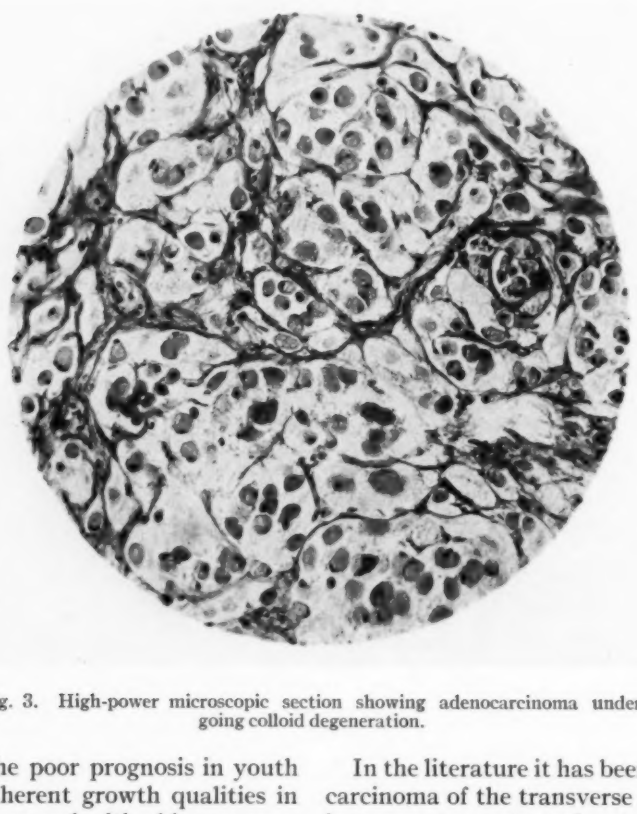

Fig. 3. High-power microscopic section showing adenocarcinoma undergoing colloid degeneration.

Apparently the poor prognosis in youth is due to the inherent growth qualities in the young as compared with older persons. What had been a well-known fact to pathologists for a long time was pointed out specifically in 1934 by Pemberton (30), who analyzed 3,542 cases of carcinoma of the colon in adults and found that "the prognosis following operation is best if the malignant growth is situated in the proximal or right portion of the colon and it (the prognosis) becomes gradually less favorable as the site of the growth becomes more distant from the right side of the colon." This might be considered a factor in the high mortality rate in very young people and, although cancer appears to be only slightly more common on the left side of the colon in the young as compared to older patients (Table I), it is also noted that there is a slightly higher incidence of malignant growth in the cecum in youth as compared to adults.

In the literature it has been reported that carcinoma of the transverse colon in adults is prone to metastasize to the stomach (31). This was not found to be true in the series of similar cases in youth. It is of interest to note that early metastases occur primarily in the nodes of the fatty tissue surrounding the malignant lesion and not in the regional lymph nodes. This was first described by Dr. P. F. Morse (31) and demonstrated in a pathological exhibit at an annual meeting of the American Medical Association in 1914.

Of the 38 young patients with carcinoma

of the colon, only 1 survived beyond a period of seven months following discovery of the lesion. Although the patient presented here is still doing well after nine months, the prognosis must be guarded.

SUMMARY

A case of carcinoma of the transverse colon in a 15-year-old boy is presented, bringing the number of cases of carcinoma of the colon to be reported in persons 15 years of age, or under, to 38.

Since the prognosis is generally bad in these cases, the hope is expressed that the mortality might be improved by more prompt diagnosis. Earlier diagnosis will be accomplished if it is kept in mind that cancer can and does occur in youth.

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Some Practical Aspects of Hip Nailing[1]

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FRACTURES OF the neck of the femur and intertrochanteric fractures are seen frequently in a general hospital practice. The more recent methods of internal fixation for these types of fracture have greatly simplified their management and have produced a much higher percentage of good functional results than was obtained with previous methods. In the placing of the mechanical aids, Smith-Petersen nails or Moore pins, the control of the position of the fragments of bone and of the appliance depends largely upon radiologic observations.

The purpose of this paper is to outline a method, developed by the author during the past several years, which provides adequate x-ray control and has the distinct advantage of materially shortening the procedure. With this method, placing of the nail or pin in the average intracapsular fracture is completed—from incision to closure—in twenty minutes, and intertrochanteric fractures require only a little longer. In two of our cases the entire procedure was completed in thirteen minutes.

A special table, constructed of wood, facilitates the procedure. This table has a double top of ordinary plywood with room between the two pieces to insert a film for anteroposterior views if these are desired. The wooden top also allows for fluoroscopic control during the course of the operation. In the upper sheet of plywood two slots are cut at an angle of 135 degrees. These extend into the table a total distance of 6 inches and are of such a width as to admit an x-ray plate. The patient is so placed on the table that the crest of the ilium will just touch the cassette when it is inserted in the slot (Fig. 1). A small portable shockproof x-ray unit is placed under the knee of the normal leg at right angles to the cassette. This provides a lateral projection of the femoral neck. A second mobile apparatus is placed beneath the table. It is equipped with fluoroscopic shutters and, with the shutters open, is used to take postero-anterior views. Thus, neither piece of x-ray equipment has to be moved during the procedure. The film is placed in the position for the lateral projection by simply raising the sterile drapes and working beneath them. The postero-anterior projection is taken by throwing a sterile sheet over the operative field and placing the cassette on top of the sheet. When fluoroscopic control is required, the surgeon works beneath the sterile sheet while the radiologist works from above. We have had no case of infection as a result of this technic.

Mr. Virgil L. Barnard of Los Angeles, Calif., has described a special top to be used upon a regular operating room table which allows anteroposterior and lateral views to be taken without disturbing the sterile operative field. Our set-up is somewhat similar, but with the following differences. The entire table top is built of wood, which allows the use of a fluoroscope in checking the insertion of the guide pin and also the insertion of the Smith-Petersen nail. A second small portable shockproof x-ray unit is used for the lateral projection. This is placed under the sterile drapes and does not interfere with the sterile field. The drapes are raised so that the film is beneath them and thus the operative field is protected.

The use of a heavy-duty mobile machine with controllable shutters beneath the x-ray table gives good visualization with the radiologist working above a sterile throw-sheet and the surgeon working below this area. Since the surgeon is working on a

[1] Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945.

Fig. 1. Patient in position on the table with the cassette inserted in the slot in the plywood top.

lateral field there is no interference between him and the radiologist. The use of a wooden table top and this technic also allow for taking postero-anterior as well as anteroposterior projections if these are more convenient, requiring no shifting of x-ray equipment in order that it may be used both for fluoroscopic and radiographic study.

Our procedure is as follows. Pentothal sodium is used intravenously as an anesthetic. While the surgeon and his assistant scrub, the reduction is accomplished by the radiologist, usually by means of abduction, external rotation, then flexion and extreme internal rotation, followed by extension. This places the neck of the femur roughly parallel to the table and offers an easier angle for driving the nail. A guide pin (Steinmann pin) is placed in the neck of the femur, either above or below the point at which the Smith-Petersen nail is to be inserted. Postero-anterior and lateral views are then taken to determine the position of the pin. With this as a guide, the Smith-Petersen nail is driven into position under fluoroscopic control, and lateral and postero-anterior views are again taken. The films are developed for one minute at 85 degrees in a small adjacent darkroom and are usually viewed before they are completely fixed.

We do not use a cannulated nail to drive over the guide pin because, on one occasion early in this series, a pin caught in the cannula of the nail and was driven into the pelvis. I have observed a similar accident at another hospital, with a fatal result.

It has been possible to follow 52 cases treated according to the method described

for a sufficient period of time to determine the final outcome. Six cases which we were unable to trace are eliminated. We have 48 cases definitely healed, the patients walking without support. There are 4 cases of non-union; in one of these there is fibrous union and the patient is walking with a cane, while another represents an old ununited fracture which was treated at the time of operation by freshening up the bone surfaces and nailing. In the other two cases there is failure of union in spite of good anatomical position.

Seven patients are listed as dead. In 3 of these the fractures resulted from metastatic carcinoma and the nailing was done for relief of pain. A fourth patient died of cerebral hemorrhage on the sixth postoperative day, and a fifth succumbed to uremia five weeks following the operation. The remaining 2 died after leaving the hospital and the cause of death was not determined.

Thus, in 83 per cent of all traced cases a good result was obtained. If the 5 cases in which the cause of death is known to be unrelated to the procedure are eliminated, the figure is raised to 90 per cent.

CONCLUSION

A simple procedure has been outlined which makes it possible to pin a fractured hip in a satisfactory fashion, very rapidly, with a minimum of shock and trauma.

A simple table of wooden construction, which can be easily made by any carpenter, is the basis for this technic, allowing fluoroscopic controls during the major portion of the procedure.

No infections have resulted from this procedure.

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Application of the Inverse-Square Law to Oil-Immersed Tubes

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DURING THE past several years, doubt has been expressed regarding the validity of applying the inverse-square law to the small oil-immersed x-ray tubes (140 kv. p. and less) which are used for both diagnostic and therapeutic purposes. This doubt has been particularly emphasized in respect to the short target-skin distances which are possible with the modern shockproof oil-immersed tube.

According to the inverse-square law, the radiation intensity at a given site varies inversely as the square of the distance from the source. It implicitly includes two factors which are often overlooked. One is that the radiation be emitted from a point source; the other that there be no absorbing or scattering media between the source and the site in question. While radiation from an x-ray tube is, of course, never actually emitted from a point source, the focal spots of these small tubes are generally so small that they can be considered practically point sources, even at short distances. The insertion of a layer of oil in the x-ray beam may, however, be an important factor in causing a deviation from the law. It was for the purpose of determining whether or not the inverse-square law could be applied under this condition that the following experimental work was done.

A wooden "jig" was constructed, into which the chamber tube of a Victoreen r-meter could be inserted at various levels. The several levels of the "jig" were so spaced that if the ionization chamber were placed in the lowest level, and then placed 20 inches from the tube target, the other levels would give distances, respectively, of 14 inches, 10.06 inches, 7 inches, and 5 inches. By the use of this "jig" it was possible to keep all operating factors constant with the exception of target-ionization chamber distance, which could be varied with extreme accuracy. Before each set of measurements, the x-ray tube was leveled with a spirit level, and the ionization chamber centered by means of a plumb-bob and divider system. If a good synchronous type timer was connected to the x-ray machine, the timing was accomplished by it; otherwise a stop watch was used.

Eleven different tubes were tested. These included Machlett Type CYS, Machlett Thermax, Machlett Aeromax, General Electric Type S.P. 140, Eureka Therograph, and Picker Airflow. Kilovoltages of approximately 80 were used. At least three determinations were made at each distance, and the arithmetic average was recorded. If one assumes a radiation intensity of 10 units at a 20-inch distance, the intensities at the other distances would be as follows, if calculated by the inverse-square law:

Distance	Intensity
5 inches	160
7 inches	81.6
10.06 inches	39.6
14 inches	20.4
20 inches	10.00

The observed intensities at the various distances were reduced to a base value of 10 units at a 20-inch distance, and these reduced values were compared with the values calculated according to the inverse-square law. The percentage of deviation of the observed from the calculated values is shown in Table I.

The arithmetic average percentage deviation at the various distances is as follows:

[1] Read by title at the Thirty-first Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 9–10, 1945.

TABLE I: RESULTS OF TESTS MADE ON ELEVEN TUBES

Tube	Distance (inches)	Observed Value	Observed Value to Base 10	Calculated Value to Base 10	Per Cent Deviation from Calculated Values
1	5	288	168.5	160	+5.2
	7	144	84.5	81.6	+3.4
	10.06	69	40.3	39.6	+1.7
	14	35	20.5	20.4	+0.5
	20	17.1	10.00	10.00	...
2	5	286	158	160	−1.3
	7	152	83.3	81.6	+2.0
	10.06	75.5	41.7	39.6	+5.0
	14	38	21	20.4	+3.0
	20	18.1	10.00	10.00	...
3	5	208	155	160	−3.2
	7	103	76.8	81.6	−5.9
	10.06	50	37.3	39.6	−5.7
	14	26	19.4	20.4	−4.8
	20	13.4	10.00	10.00	...
4	5	232	161	160	+0.6
	7	119	82.5	81.6	+1.0
	10.06	57.5	39.9	39.6	+0.7
	14	29	20.1	20.4	+1.5
	20	14.4	10.00	10.00	...
5	5	408	162	160	+1.3
	7	205	81.2	81.6	−0.5
	10.06	99	39.3	39.6	−0.7
	14	50.3	20	20.4	−2.0
	20	25.2	10.00	10.00	...
6	5	283	156	160	−4.0
	7	147	81	81.6	−0.75
	10.06	71	39.2	39.6	−1.0
	14	36.5	20.2	20.4	−1.0
	20	18.1	10.00	10.00	...
7	5	432	160	160	0.0
	7	222	82.2	81.6	+0.6
	10.06	105	38.7	39.6	−2.2
	14	54	20	20.4	−2.0
	20	27	10.00	10.00	...
8	5	392	170	160	+6.0
	7	200	86.8	81.6	+6.0
	10.06	94	40.8	39.6	+3.0
	14	46.5	20.5	20.4	+0.5
	20	23	10.00	10.00	...
9	5	99	156	160	−2.6
	7	51.3	78.8	81.6	−3.5
	10.06	24.6	37.8	39.6	−4.5
	14	12.5	19.2	20.4	−5.8
	20	6.5	10.00	10.00	...
10	5	140	170	160	+6.0
	7	69	83.8	81.6	+3.6
	10.06	33.4	40.6	39.6	+2.4
	14	16.8	20.4	20.4	0.0
	20	8.23	10.00	10.00	...
11	5	306	153	160	−4.5
	7	156	78	81.6	−4.3
	10.06	81.9	41	39.6	+3.4
	14	41.1	20.5	20.4	+0.6
	20	20	10.00	10.00	...

5 inches	+0.318%
7 inches	+0.15%
10.06 inches	+0.19%
14 inches	−1.0%
20 inches	0.0%

In analyzing these data, it is to be remembered that the figures represent the error to be expected when a measurement is made at a 20-inch distance and the inverse-square law is applied to calculate the intensity at the shorter distances. Quite obviously these errors are so small as to have no practical significance.

The averages given are for the eleven tubes and show that, on the average, the inverse-square law may be applied between 20 and 5 inches with an error not greater than 1 per cent. For individual tubes the error appears somewhat larger. A maximum positive deviation of 6 per cent was noted several times, as well as several negative deviations of about the same magnitude. Since these maximum deviations occur at various distances, and are both positive and negative, it is probable that they reflect nothing other than experimental errors.

The above deviations are small, despite the fact that the measurements were deliberately made in a manner to cause the inverse-square law to appear in its worst light: measurements made at maximum distance and calculations made from maximum to minimum distance. In practical work, if one wished to make only one determination and then calculate intensities at other distances, he would hardly start at a maximum distance and calculate to a minimum. Rather, he would make the single measurement at about the middle distance and calculate to both the longer and shorter distances. If this procedure were followed, the maximum deviations or errors would be even smaller than those given above.

CONCLUSIONS

The inverse-square law may be applied in calculating variation in radiation intensities at distances from 20 inches to 5 inches with an average error not exceeding 1 per cent, and a maximum error not exceeding plus or minus 6 per cent.

My thanks are extended to the several radiologists and dermatologists who gave their kind permission for the use of their equipment for the above experiment.

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EDITORIAL

Frederick W. O'Brien, M.D.

President of the Radiological Society of North America

Frederick W. O'Brien, popular president of our Society for 1947, is the first representative from New England to be elected to this post. For those not acquainted with him and with his numerous contributions to radiology, a brief review of his characteristics and career will be of interest. It should be, too, an incentive to younger men entering this specialty.

Dr. O'Brien's training and career indicate that a sound educational program was instituted from the start. He received his preparatory education in the public schools of Boston and his Bachelor of Arts degree from Boston College. He was graduated from Tufts Medical School in 1911, following which he practised general medicine for a period of three years. In 1914 he entered the field of radiology. For instruction in this new specialty he went to Vienna, where he studied under Kreusfuchs and Schüller, and on his return to Boston, he took further training under Arial W. George. The practice of radiology at that time was undergoing rapid changes. Deciding that further education would be of value, Dr. O'Brien became a graduate student at Harvard College, where he studied in the physical laboratory under Duane (radiation physics and biophysics) during 1920, 1921, 1922, and 1923.

In 1918, Dr. O'Brien became an instructor in Tufts Medical College, and has been successively assistant professor, associate professor, professor, and, since 1941, professor emeritus in radiology in his mother institution. He has been visiting roentgenologist to the Cambridge Municipal Hospital since 1918 and chief of the Tumor Clinic at the Boston City Hospital since 1939.

To name all of the positions which our new president has held would be to fill this short brief with more lists than is feasible. Some of the posts which will have special significance for our membership are as follows: president of the New England Roentgen Ray Society, 1924–25; president of the American Radium Society, 1940; Chancellor of the American College of Radiology, 1941; diplomate and trustee of the American Board of Radiology, 1940; member of the British Institute of Radiology since 1931.

Dr. O'Brien is an excellent speaker and has taken part in many symposia, especially on the treatment of malignant disease. Carcinoma of the breast and cervix, two lesions which require thought and action in order that treatment of the patient will be best carried out, have been of special interest to him. I shall not list the articles which he has written or the addresses which he has given other than to say that he was the Janeway lecturer for the American Radium Society in 1946, when he spoke on the treatment of carcinoma of the cervix.

Our president's main interest outside of medicine is his family. He is married to Sara Green and they have three children: a son, now interning at the Boston City Hospital, a second son in premedical school, and a daughter, a senior at Trinity College, Washington, D.C.

The election of Frederick W. O'Brien to the presidency of the Radiological Society of North America gives us a man whose keenness and sharpness of mind are reflected in his own meticulous appearance.

HUGH F. HARE, M.D.

FREDERICK W. O'BRIEN, M.D.

President, Radiological Society of North America

The Loch Ness Monster

The Loch Ness monster appears every few years to perturb the quiet Highlanders of Northern Scotland. Similarly, some hospital administrator or medical politician brings out from time to time the old proposal to divide radiology into technical and professional portions.

It would appear that these persons have not read nor appreciated the article on this subject, prepared by the Executive Committee of the Pacific Roentgen Club, appearing in RADIOLOGY nearly a decade ago (**29:** 732–734, December 1937), nor the numerous discussions in other radiological journals and in the *Bulletin* of the American College of Radiology. A study of these papers will disclose the fact that organized Radiology is determined to stand by the basic principle that the x-ray examination is, and always has been, fundamentally a medical procedure and must be directed and controlled by a physician trained in radiology. In nearly every medical specialty there are technical procedures which are a part of that specialty and cannot be divided from it.

It is therefore timely to bring before our readers, whether or not they be members of the Radiological Society of North America, the following Resolution, adopted unanimously at the Annual Meeting of the Society in December 1946.

WHEREAS: One of our Counselors reports a regrettable state of affairs in his State; therefore be it

Resolved: That the members of the Radiological Society of North America be reminded by means of a special editorial announcement in our Journal that it is the considered opinion of organized Radiology that the division of medical fees into so-called technical and professional portions is artificial, unsound, and inimical to the future of good medical care.

CANADIAN ASSOCIATION OF RADIOLOGISTS

The Tenth Mid-Winter Meeting of the Canadian Association of Radiologists was held in Quebec, Jan. 3-5, with a program of great interest, including many phases of roentgen diagnosis and radiotherapy. The officers of the organization are: Dr. C. W. Prowd of Vancouver, President; Dr. Digby Wheeler of Winnipeg, Vice-President; Dr. E. M. Crawford of Montreal, Honorary Secretary-Treasurer.

IVème CONGRES DES MEDICINS ELECTRO-RADIOLOGISTES DE LANGUE FRANCAIS

The Fourth Congress of French speaking electroradiologists was held in Paris Oct. 9–12, 1946, under the presidency of Dr. Delherm. The program included special reports on "Chronic Vertebral Rheumatism" by Dr. Lachapele of Bordeaux, "Clinical Encephalography" by Professor Baudoin and Dr. Fischgold of Paris, "Low-Voltage, Near-Distance Roentgen Therapy in Dermatology" by Dr. Paul Bourdon and Dr. René Bourdon of Paris, and "Contact Radiotherapy for Cancer of the Rectum" by Professor Paul Lamarque and Dr. Charles Gros of Montpelier, as well as a large number of other papers.

NUCLEAR RESEARCH

Entrance of the U. S. Public Health Service into the nuclear research program at Clinton Laboratories, Oak Ridge, Tenn., operated by the Monsanto Chemical Company, and the organization of a new Biological Research Division as a cooperative undertaking with the National Institute of Health has recently been announced here. The program will include extensive research into the effect of nuclear radiations upon living cells and studies of the maximum safe exposure for workers in this field. Dr. Alexander Hollaender, principal biophysicist of the National Institute of Health, has been assigned to the Clinton Laboratories as head biophysicist.

This cooperative undertaking will permit the National Institute of Health to take advantage of new tools now being made available at the Clinton Laboratories in its research program on such subjects as infectious diseases, nutrition, tropical disease, cancer, and fundamental studies in biochemistry and physiology. It also allows the National Institute of Health to train scientific personnel in this new field, both in fundamental biological research and health protection procedures.

The work of the Division will be divided into the following units: biochemistry, cytogenetics, general physiology, experimental radiology, and a section of co-operative studies.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE MEDICAL ANNUAL 1946. A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX. Editors Sir HENRY TIDY, K.B.E., M.A., M.D., B.S. (Oxon.), F.R.C.P., and A. RENDLE SHORT, M.D., B.Sc., F.R.C.S. Published by John Wright & Sons Ltd., Bristol, and Simpkin Marshall (1941) Ltd., London.

GASTROENTEROLOGY IN GENERAL PRACTICE. By LOUIS PELNER, M.D., Associate Attending Physician, Greenpoint Hospital, Brooklyn, N. Y.; Associate Visiting Physician, Brooklyn Cancer Institute; Adjunct Physician, Beth Moses Hospital, Brooklyn, N. Y., with the Collaboration of LOUIS A. HELD, M.D., Attending Roentgenologist, Beth Moses Hospital, Brooklyn, N. Y., and contributions from ALEXANDER LEWITAN, M.D., Consulting Roentgenologist, Norwegian Public Health Service, New York; Adjunct Roentgenologist, Beth Israel Hospital, New York; SAMUEL WALDMAN, M.D., Associate Attending Physician, Greenpoint Hospital, Brooklyn; SIEGFRIED W. WESTING, M.D., Roentgenologist, Brooklyn Cancer Institute. A volume of 285 pages, with 109 illustrations, including 19 color plates. Published by Charles C Thomas, Springfield, Ill., 1946. Price $7.50.

Book Reviews

PRINCIPLES IN ROENTGEN STUDY OF THE CHEST. By WILLIAM SNOW, M.D., Director of Radiology, Bronx Hospital; Roentgenologist-in-Charge, Harlem Hospital, New York City. A volume of 414 pages, with 508 illustrations. Published by Charles C Thomas, Springfield, Ill., 1946. Price $10.00.

The preface to this new volume on roentgenology of the chest opens with the truism that "Roentgen interpretation in clinical medicine requires in most instances a correlation of the history, physical signs, and knowledge of physiology and pathology." Evidently with this in mind, the author has in many chapters given considerable space to the clinical aspects of his subject, but in others the descriptions are somewhat scanty. Much attention is paid to the changing pattern of the roentgen picture during the course of various diseases.

The first three chapters of the book deal with the

technic of roentgenography of the chest, the normal lung, and the role of the bronchial tree. Subsequent chapters take up various infections of the lungs and pleura, neoplasms, pneumoconiosis, emphysema, etc. There are also chapters devoted to the mediastinum, the diaphragm, the circulatory system, and special chest problems in children.

The large number of illustrations almost puts the books in the atlas class. There are, for example, 35 pages of cuts illustrating lobar pneumonia with eight pages of text. Unfortunately the reproductions are not always of top quality.

References to other writers have been kept to a minimum in favor of simplicity of presentation, and while a bibliography is appended, no pretensions are made as to its completeness.

A MANUAL OF TOMOGRAPHY. By M. WEINBREN, B.Sc. (S.A.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.F.R. (Lond.), D.M.R.E. (Camb.), Lt. Col. S.A.M.C. Adviser in Radiology, Union Defence Force; Radiologist, Chamber of Mines Hospital, Johannesburg; Late Radiologist, Queen Mary's Hospital (Roehampton), Ministry of Pensions; Assistant Radiologist, The Middlesex Hospital (London). A volume of 270 pages, with 138 figures comprising 397 illustrations. Published by H. K. Lewis & Co. Ltd., London, 1946. Price 45 s. net.

This "Manual of Tomography" is the outgrowth of a lecture given by the author before the Capetown (South Africa) Postgraduate Medical Association in 1944. It is based on an experience of seven years, during which he has found this technic increasingly indispensable. In the introductory chapter, he presents briefly the principles of the procedure, touching upon its history and including illustrations and brief descriptions of the apparatus employed. Subsequent chapters cover examination of the chest, spine, skull, larynx, etc. A separate chapter on technic concludes the work.

The author's descriptions present tomography in its best light, but frequently the routine roentgenograms appear to show the pathological lesion as well or better than the tomogram. There are areas, however, where standard films are not satisfactory, and here tomography finds its chief indication.

The book is attractive in general format, and numerous illustrations demonstrate adequately the conditions discussed. A satisfactory index is appended. Roentgenologists interested in tomography will find this volume useful, and to them it is recommended.

A HANDBOOK OF RADIOGRAPHY. By JOHN A. ROSS, M.A. (Camb.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.M.R.E. (L'pool), Visiting Radiologist, Alder Hey Children's Hospital, Liverpool; Hon. Radiologist, Warrington Infirmary, Warrington; Radiologist, General Hospital, Warrington; Hon. Radiologist, The St. Helens Hospital, St. Helens, Lancs.; Clinical Assistant, X-Ray Department, Royal United Hospital, Liverpool; Assistant Lecturer in Radiology, University of Liverpool. A volume of 165 pages with 92 illustrations. Published by H. K. Lewis & Co., Ltd., London, 2nd ed., 1946. Price 10/6d net.

This is a small handbook of convenient size to slip in the pocket, designed for x-ray technicians and students. It is written in an intimate, almost conversational style, giving many of the "do's and don't's" which would be less easily imparted in a more formal book.

The subject matter covers many of the standard positions in ordinary use, giving helpful suggestions for position of patients and calling attention to pitfalls which are likely to be encountered in the examination. In fact, the greatest usefulness of the book is found in these helpful suggestions.

The illustrations are outline sketches which serve more to refresh the memory of a technician already familiar with the position than to provide a detailed account of how to carry out the procedure.

The only criticism which could be offered of this excellent little book is that it attempts descriptions of so wide a variety of special examinations that none can be entirely adequate.

CHECK AND DOUBLE CHECK ON SICKNESS INSURANCE. By J. WESTON WALCH, Instructor in Economics and Business Law, Portland (Maine) High School. Published by the Public Relations Bureau, Medical Society of the State of New York, 1946. A 60-page paper-bound pamphlet. Price 25 cents for separate copies; special prices in quantity.

This little pamphlet on compulsory sickness insurance deals with the subject from the point of view of an average citizen. It is indeed the work of an average citizen, a high-school instructor who made a special study of sickness insurance in preparation of a handbook for use of participants in nation-wide high-school debates. It is designed especially for community leaders, and others who are called upon to present this subject to the public.

Following an introduction stating the problem, the text is in the form of 133 questions and answers grouped under four main headings: "The Quality of Medical Care Today"; "Paying for Medical Care"; "Compulsory Sickness Tax"; "Voluntary Medical Care Insurance." The "Ten Point Health Program of the American Medical Association" and ten major arguments against the Murray-Wagner-Dingell bill taken from an address made by Dr. Haven Emerson before the 1946 National Conference on Co-operative Health Plans appear as appendixes.

"For your own sake, check and double check all the facts on this vitally important subject," says the author. For that purpose this little booklet is recommended.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to cooperate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates. Address: Howard P. Doub, M.D., The Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 607 Medical Arts Bldg., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY *Secretary*, Hugh F. Hare, M. D , 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Harold Dabney Kerr, M.D., Iowa City, Iowa.

AMERICAN COLLEGE OF RADIOLOGY *Secretary*, Mac F. Cahal, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John Day Peake, M.D., Mobile Infirmary, Mobile. Next meeting at the time and place of the Alabama State Medical Association meeting.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M. D., Pine Bluff. Meets every three months and annually at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, D. R. MacColl, M.D., 2007 Wilshire Blvd., Los Angeles 5.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION. *Secretary*, Moris Horwitz, M.D., 2009 Wilshire Blvd., Los Angeles 5. Meets second Wednesday of each month at County Society Bldg.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with California Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, Joseph Levitin, M.D., 516 Sutter St., San Francisco 2. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year in Lane Hall, Stanford University Hospital, and second six months in Toland Hall, University of California Hospital.

Colorado

DENVER RADIOLOGICAL CLUB. *Secretary*, Washington C. Huyler, M.D., Mercy Hospital, 1619 Milwaukee, Denver 6. Meets third Friday of each month, at the Colorado School of Medicine and Hospitals.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Robert M. Lowman, M.D., Grace-New Haven Hospital, Grace Unit, New Haven. Meetings bimonthly, second Thursday.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maxey Dell, Jr., M.D., 333 West Main St., S., Gainesville.

Georgia

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer* James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, T. J. Wachowski, M.D., 310 Ellis Ave., Wheaton. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April, at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Frank S. Hussey, M.D., 250 East Superior St., Chicago 11.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, J. A. Campbell, M.D., Indiana University Hospitals, Indianapolis 7. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney E. Johnson, M.D., 101 W. Chestnut St., Louisville.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday, 7:30 P.M.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, Charles N. Davidson, M.D., 101 West Read St., Baltimore 1.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Regular meetings in the Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, John W. Walker, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Edwin C. Ernst, M.D., 100 Beaumont Medical Bldg. Meets on fourth Wednesday of each month, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. A. Neely, M.D., 924 Sharp Building, Lincoln. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary-Treasurer*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, W H. Seward, M.D . Orange Memorial Hospital, Orange. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway, L. I.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Abraham H. Levy, M.D., 1354 Carroll St., Bklyn. 13. Meets fourth Tuesday of every month, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month, October to May, inclusive.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings in January, May, and October.

LONG ISLAND RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Wm. Snow, M.D., 941 Park Ave., New York, 28.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary*, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meets at Strong Memorial Hospital, third Monday, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary-Treasurer*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 1338 Second St., N., Fargo

Ohio

OHIO RADIOLOGICAL SOCIETY. *Secretary*, Henry Snow, M.D., 1061 Reibold Bldg., Dayton 2. Next meeting at annual meeting of the Ohio State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Hugh A. Baldwin, M.D., 347 E. State St., Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Carroll C. Dundon, M.D., 11311 Shaker Blvd. Cleveland 4. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists). *Secretary-Treasurer*, Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meets third Tuesday of each month.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Peter M. Russo, M.D., 230 Osler Building, Oklahoma City. Meetings three times a year.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Calvin L. Stewart, M.D., Jefferson Hospital, Philadelphia 7. Meets first Thursday of each month at 8:00 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22d St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Lester M. J. Freedman, M.D., 415 Highland Bldg., Pittsburgh 6. Meets second Wednesday of each month at 6:30 P.M., October to May, inclusive.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. M. Popma, M.D., 220 N. First St., Boise, Idaho.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meetings on third Monday of each month, in Dallas in the odd months and in Fort Worth in the even months.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth 4.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. Lowry Allen, M.D., Judge Bldg., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

UNIVERSITY OF UTAH RADIOLOGICAL CONFERENCE. *Secretary*, Henry H. Lerner, M.D. Meets first and third Thursdays, September to June, inclusive, at Salt Lake County General Hospital.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, E. Latan Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederic E. Templeton, M.D., 324 Cobb Bldg., Seattle 1. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, S. R. Beatty, M.D., 185 Hazel St., Oshkosh. Two-day meeting in May and one day at annual meeting of State Medical Society in September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 to 5 P.M., September to May, inclusive, Room 301, Service Memorial Institute, 426 N. Charter St., Madison 6.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D., 2100 Marlowe Ave., Montreal 28, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets on third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Colloid (Paraphisial) Cysts of the Third Ventricle. Archer A. Wilson. West Virginia M. J. **42:** 49–53, March 1946.

Colloid, paraphysial, or neuro-epithelial cysts arise from the velum transversum of the anterior part of the roof of the third ventricle, from an embryonic anlage of the paraphysis, which is a rudimentary structure in man but is fully developed in the lower vertebrates as the paraphysial gland. Owing to the narrow confines of the ventricle and to their anterior location, these cysts may block the foramina of Monro and thus give rise to dilatation of both lateral ventricles, with production of symptoms indicating an acute increase in intracranial pressure, namely headache, nausea and vomiting, dizziness, visual disturbance, and perhaps unconsciousness, convulsions, apathy, stupor, mental symptoms, vegetative disturbances, and even sudden death. Since the tumors are more or less suspended above the foramina of Monro, the obstruction may be intermittent, depending upon postural changes.

A case is reported in a 24-year-old man who for three years had been subject to bouts of generalized headaches, often of sudden onset. In the last few months he had experienced attacks of dizziness when stooping over, but there was no definite history of nausea, vomiting, or other symptoms suggesting an intracranial lesion. The physical examination was essentially negative, except for a slight increase in the size of both blind spots.

Ventriculograms showed greatly dilated lateral ventricles with a small amount of air in the third ventricle, and no shift, findings indicative of a mid-line tumor obstructing the foramina of Monro and therefore in the anterior part of the third ventricle. A right frontal craniotomy was performed, and the third ventricle was approached through a cone-like incision in the frontal lobe. As the right foramen of Monro was exposed, a smooth, grayish, glistening mass was seen presenting through the foramen. The foramen was enlarged and the tumor was removed with ease and without hemorrhage. The patient was entirely relieved of his symptoms. Three years later he was passed by his local draft board for induction.

The pathological specimen consisted of almost entirely coagulated, partly laminated, colloid-like material, including only a few cells. In one area some bipolar and multipolar cells resembling astrocytes were found. No cyst wall was demonstrable.

J. E. WHITELEATHER, M.D.

Leptomeningeal Cyst Associated with Hemiplegia and Skull Defect of Traumatic Origin. Moses Cooperstock. J. Pediat. **28:** 488–492, April 1946.

Leptomeningeal cysts, with associated skull defect and hemiplegia, are produced by severe head trauma invariably accompanied by skull fracture, usually of the comminuted or depressed variety. The cysts develop as the result of laceration of the arachnoid, pia mater, and in many cases the dura mater as well. The skull defect is the result of resorption of the bone overlying the cyst and is brought about by the pulsating pressure of the brain, much as bone resorption is produced by aortic aneurysms in proximity to such bony structures as the sternum, ribs, and vertebrae. The neurologic changes are due to destruction of the regional cortical tissue of the brain.

In the author's case this syndrome followed a severe skull fracture sustained at the age of five months. The patient was observed over a period of ten years, until operation was undertaken.

Roentgen studies of the skull on the day of the accident showed a fracture extending from the sagittal suture into the mid-portion of the right parietal bone, as well as less prominent linear fractures in this area. There was also a suggestion of a fracture through the occipital squama. The presence of a depressed fracture in this film was not definitely apparent. Roentgenograms taken after four and one-half months showed a later area of bone resorption, made up of circumscribed areas of rarefaction with slight sclerotic change at their margins. Films taken periodically over the next ten years showed persistence of the defect. There was suggestion of a disturbance of ossification as evidenced by the irregularly increasing thickness of the skull in the involved area.

The first evidence of hemiplegia was weakness of the left arm apparent at the age of seven months, followed by weakness of the left leg. Moderate atrophy of both extremities developed in the ensuing years.

At operation the left meningeal cyst was opened and 10 c.c. of fluid were removed. The cortex of the underlying brain appeared to be destroyed for a depth of 2.0 cm. The bony defect was closed with a tantalum plate. The results of this procedure are not recorded.

An awareness of the possible presence of a leptomeningeal cyst together with repeated roentgen examination of the skull for the detection of bone resorption in such cases in young infants will doubtless lead to earlier diagnosis and to prompt surgical treatment.

Aerohematoma of the Sinuses. R. Wesley Wright and Harold M. E. Boyd. Arch. Otolaryng. **43:** 357–370, April 1946.

Hematoma of the paranasal sinuses is a relatively new and interesting diagnostic entity emerging from the accelerated flying program of the war. It is a rather uncommon finding associated with obstructive aerosinusitis and, because of its relationship to the latter condition, it is suggested that the term "aerohematoma" be applied to it. Twelve cases were studied by the authors during a two-year period. In 11 of these cases the hematoma occurred during a simulated flight in the low-pressure chamber. These were the only cases encountered in over one hundred thousand such flights.

The outstanding symptom in the authors' cases was pain coming on during actual or simulated flight. Other symptoms were soreness over the sinus areas, numbness of the face and teeth, discharge of fresh or old blood from the nose and, in a single case, dizziness. In 8 of the 12 cases there was a history of a slight cold or sinusitis at the time of the flight.

Roentgenograms in cases of hematoma usually show a well defined round shadow. Later the entire sinus may become cloudy, probably from the accompanying reaction to the blood. The discrete shadow is then no

longer visible and the appearance is indistinguishable from sinusitis of any sort. The round shadow often does not appear again, as resorption occurs, and the entire cloudiness clears up at the same time. In cases of antral cyst, which on the roentgenogram may resemble hematoma, a discrete round shadow is often obscured by reaction which, on clearing, reveals the shadow again.

The time necessary for resorption of the hematoma in 11 cases was about three to ten weeks. The exact number of days in any case is only an approximation, as roentgenograms were not spaced close enough or taken soon enough after flight for exact determination. In one case, the pain was so severe that the involved antrum had to be opened and the hematoma removed.

Present Status of Localization of Intra-Ocular Foreign Bodies. P. Porcher, C. Gianturco, E. Gilles, and J. Barbadault. J. de radiol. et d'électrol. **27:** 1-10, 1946.

The authors describe the various methods of localization of foreign bodies in the eye and present the indications for each.

The method of *Sweet*, the first standard procedure, was brought out about 1909 and has been so modified as to gain in simplicity and usefulness. The authors give a comprehensive and unusually illuminating description of the procedure and apparatus, dealing fully with the construction of the graph. They list the causes of error under two heads; errors of manipulation and technic and errors inherent in the method itself. Stevenson has worked out on geometrical lines eight possible positions of the foreign body in a theoretical sphere where accuracy cannot be expected with the Sweet method.

The physiological method of *Porcher* is based upon movements of the orbit. It does not necessitate apposition of the cornea to any instrument and thus avoids further trauma to the eyeball. The technic and sources of error are fully discussed.

Gianturco's method [see Radiology **40:** 371, 1943] is based upon stereoscopy in the anteroposterior and lateral projections, and the caution is given that the cassette must be placed very exactly for the two exposures. In the modification made by Pfeiffer, special apparatus is employed, with a correction chart.

Publication of a new stereoscopic method devised by Chausse is promised for the future.

PERCY J. DELANO, M.D.

Sialography. T. E. Beyer. Rocky Mountain M. J. **43:** 210-216, March 1946.

For sialography from 1.0 to 1.75 c.c. of warm lipiodol is injected into Steno's duct following surface anesthetization of the papilla with pontocaine. Lateral and posterior films made immediately thereafter will show characteristic shadows in the presence of radiopaque calculi, chronic parotitis (acute parotitis is a contraindication), fistulae, and xerostoma, and will distinguish between extrinsic neoplasms and those of the gland substance. The procedure also makes possible the differentiation of benign mixed tumors and those which have undergone malignant change, with invasion of neighboring tissues, but radical surgery for a malignant lesion should not be based solely on the roentgen findings.

Wharton's duct may also be injected with lipiodol (about half as much as in the parotid duct), but the procedure is of limited value for the demonstration of submaxillary gland tumors.

The article contains many interesting illustrations.

PERCY J. DELANO, M.D.

Dysphagia Due to Causes Other than Malignant Disease. A. S. Johnstone. Edinburgh M. J. **53:** 160-172, April 1946.

Pathological conditions producing dysphagia are discussed and classified according to the age groups in which they are most commonly found in the radiological department of a general hospital. Congenital atresia and congenital stricture, web, shortening, and spasm of the esophagus are the most frequent causes of dysphagia in the first decade of life; congenital stenosis and simple stricture in the second; achalasia in the third; post-cricoid web in the fourth and fifth; peptic ulceration of the esophagus and partial thoracic stomach in the fifth to seventh. Pharyngeal diverticulum is usually seen after the age of sixty. Other conditions found in the older group are tertiary contractions, benign tumors, nervous lesions, and extrinsic pressure from cardiovascular conditions. The fluoroscopic and roentgen findings are described.

THE CHEST

Pulmonary Function Tests. G. G. Ornstein, Myron Herman, M. W. Friedman, and Ernest Friedlander. Am. Rev. Tuberc. **53:** 306-332, April 1946.

Pulmonary function can be judged on the basis of three factors: (1) ventilatory capacity, (2) permeability, or the diffusion of oxygen and carbon dioxide in the alveolar component of the lung, and (3) extraneous factors such as toxemia, anemia, etc.

The simplest ventilatory test is the measurement of the vital capacity and its comparison with the calculated normal vital capacity. One means of measuring ventilatory capacity is to determine the maximum breathing capacity by having the subject, connected to a spirometer, breathe as deeply and as rapidly as possible for thirty seconds, the results being recorded on a moving drum. It has been determined that the average maximum breathing capacity for males is 154 liters per minute, for females 100 liters per minute. The average resting minute ventilation has been found to be 7.5 liters for either sex. By dividing the maximum by the resting minute ventilation the authors determine what they designate the "ventilatory reserve namely," 20 for males and 13 for females. They believe this calculation offers the most information that can be obtained on ventilatory capacity, since variation in either the resting or the maximum breathing capacity will affect the end-result. It has been shown that when the ventilatory function of the lungs is reduced below 60 per cent of the calculated normal vital capacity, dyspnea will appear on exertion.

The authors describe a method for measuring the efficiency of alveolar permeability using a rebreathing apparatus and include tables showing the normals for males and females.

A series of patients with impaired lungs was studied, and a number of the case reports, with reproductions of roentgenograms, are published. It became apparent that the roentgenogram was of limited value in estimating the capability of the lungs to diffuse oxygen and carbon dioxide. In some instances the roentgenogram

showed an extensive bilateral infiltration of the lungs, and in such cases the ventilatory function was also markedly impaired. Yet the diffusion test indicated that the lungs were capable of diffusing oxygen and carbon dioxide as well as the lungs of a normal subject. It is apparent, therefore, that complete information concerning pulmonary function cannot be obtained unless the efficiency of alveolar permeability is determined in addition to the ventilatory reserve.

L. W. PAUL, M.D.

Primary Lung Cancer in Childhood. Report of an Unusual Case. Archibald Dick and Hugh Miller. Brit. M. J. **1:** 387–388, March 16, 1946.

In a case of primary lung cancer in a 9-year-old girl, the correct diagnosis was not established until autopsy. A single metastasis in the left femur produced symptoms eight months before the pulmonary lesion was recognized. Histologic examination of necrotic material from the bone first suggested the possibility of a neoplastic process. The local response to deep x-ray therapy (2,000 r) was satisfactory and substantiated this diagnosis. A roentgenogram of the chest at this time showed enlarged partially calcified hilar and peribronchial nodes, with peribronchial thickening in the upper lung fields. When the patient returned to the hospital four months later with pulmonary symptoms, the first impression was that she had secondary deposits in her right lung causing a massive effusion. The roentgenographic findings were now consistent with those of a massive pleural effusion, and it was not until a second aspiration was attempted that a large malignant tumor of the right lung was recognized. This was thought to be secondary to the lesion of the femur. X-ray therapy to the chest was carried out as long as the patient's condition permitted (ten days). She died about two weeks later. At autopsy the primary tumor was found to be a bronchial carcinoma, while the lesion of the left femur was secondary.

Multiple Pulmonary Hemangiomata. Paul Todd Makler and David Zion. Am. J. M. Sc. **211:** 261–266, March 1946.

A pulmonary hemangioma, called also pulmonary arteriovenous fistula, is a knot of blood vessels connected by feeder vessels to both the pulmonary arterial and venous circulations so that the blood can pass from the arterial to the venous side without being oxygenated. All changes other than the low oxygen saturation are secondary to the anoxemia.

A case is reported of a young man who had experienced severe cyanosis and mild dyspnea on exertion since the age of fourteen. The fingers were markedly clubbed. A slight polycythemia was present. A chest film made at the age of seventeen was called normal. The patient was discharged at that time with a diagnosis of congenital heart disease, probably interauricular septal defect, but the diagnosis was considered unsatisfactory because of the absence of a murmur. At the latest admission, three years later, a small telangiectasis was present behind the right ear. A murmur was heard in the left fourth interspace. A review of the old films showed a nodule in the right lung measuring 2.0 cm. and one in the left lung measuring 3.0 cm. Fluoroscopically, these, and others which developed later, varied in size with changes in intrathoracic pressure during the Valsalva experiment. The nodules were connected with each hilum by linear shadows which were interpreted as feeder vessels.

The authors rule out lesions other than pulmonary hemangiomata by exclusion. They compare their case with 7 cases of pulmonary hemangioma found by them in the literature. All of the other cases have also been in young adults. Dyspnea, cyanosis, finger clubbing, and polycythemia have been common to all. None of the patients had demonstrable cardiac or lung disease. Four had known hemangiomata elsewhere, and three had multiple pulmonary lesions. Hemorrhage occurred in two cases.

The most important lesion to rule out in the differential diagnosis is congenital heart disease.

BENJAMIN COPLEMAN, M.D.

A Roentgen Ray and Clinical Study of Primary Tuberculosis. Vollmer Patch Test Made on Four Hundred and Sixty Patients; Positive Reactions Secured in One Hundred and Fifteen. Alfred D. Biggs, with technical assistance of Irene Stolp. Arch. Int. Med. **77:** 393–404, April 1946.

In a series of 460 children studied for tuberculosis by the Vollmer patch and purified protein derivative tests at St. Luke's Hospital, Chicago, 115 reacted to at least one of the tuberculin tests. The Vollmer patch test agreed with the purified protein derivative test in 100 out of the 115 cases. Of the 15 children in whom the tests did not agree, 14 had positive reactions to one of the purified protein derivative tests and a negative reaction to the Vollmer patch, while in one child the converse was true. These facts indicate that neither test is infallible and that the Vollmer patch test is slightly less sensitive.

Each of the 115 children reacting positively to tuberculin was examined at least once roentgenologically. In more than half, serial roentgenograms were made over a period of five years, and in some over a period of ten years. The lesion of primary pulmonary tuberculosis appears first peripherally. The usual location is the first, second, or third intercostal space on either the right or left side or, more commonly, on both sides. It may also be in the apex. This initial lesion is rather ephemeral and rapidly hardens. At the same time, the shadows of the hilar lymph nodes enlarge. The end-results are calcified hilar nodes and linear peripheral markings. In the present series a Ghon tubercle was decidedly the exception. Calcification of the hili occurred in 84 cases.

The majority of the patients in the present study had calcified nodes at the first examination. In 18, calcification began while the patients were under observation. The interval between the first roentgenogram showing tissue change and one showing calcium shadows varied from a few months to three years; in the majority it was between six months and two years.

Standardization of Photofluorographic Equipment. Russell H. Morgan and Willard W. Van Allen. Am. Rev. Tuberc. **53:** 291–296, April 1946.

Due to recent expansion in the number of companies producing photofluorographic equipment, it seemed desirable to bring about some degree of standardization in basic design. The Tuberculosis Control Division of the U. S. Public Health Service requested the National Electric Manufacturers Association to call a meeting of representatives of the x-ray industry for discussions on

the subject. As a result of this meeting and of subsequent research, it was decided to standardize 70-mm. photofluorographic equipment as follows:

(1) The photofluorographic film should be of the blue-sensitive type.
(2) Photofluorographic screen should be of the blue-emitting type.
(3) Photofluorographic screen should be 15 × 17 inches in size.
(4) The distance from the x-ray tube to the photofluorographic screen should be 40 inches.
(5) The x-ray tube shift for stereoscopy should be 2.5 inches.
(6) The distance between the centers of successive exposures on the 70-mm. film-roll should be 3.25 inches.

L. W. PAUL, M.D.

Photofluorographic Roll-Film Viewers. Ira Lewis. Pub. Health Rep. **61:** 294–297, March 1, 1946.

For the most part, direct viewing systems have been used in America for the interpretation of photographic films, whereas in Great Britain the projection system has been preferred. A study was made of the relative merits of the two methods by the Radiology Section of the Tuberculosis Control Division (U. S. Public Health Service). The optimum conditions under which photofluorographic films are viewed require that the following criteria be observed: (1) all detail which is present in the film must be reproduced at the retina of the observer's eye, (2) eye strain must be reduced to a minimum, and (3) mechanical operation of the viewing device must be as simple as possible. Although in the past the projection system of viewing has been in many respects preferable to the direct system, the direct viewers now becoming available overcome the previous difficulties and are felt to offer the closest approach to the ultimate in viewing system design.

Separation Center Chest Survey. Louis Schneider. Dis. of Chest. **12:** 147–152, March-April 1946.

During the first six months of operation of the Fort Dix Separation Center, 9,658 enlisted men, 1,084 officers, and 291 women were discharged for other than physical reasons. A photoroentgen chest survey (4 × 5-inch film) prior to discharge showed no evidence of pulmonary disease in any of the women. The findings in the 10,742 men were as follows:

Pulmonary tuberculosis: 4 minimal active cases (induction films had been negative less than two years earlier), subsequently proved by hospital study; 3 additional cases, unproved; 1 bilateral actively advancing case; 26 cases of healed or arrested foci. The incidence of new cases of pulmonary tuberculosis in previously screened men who had seen active service for about two years was thus less than one in two thousand.

Atypical pneumonia: 11 cases.

Pneumoconiosis: 3 cases, all in former coal miners.

Bullous emphysema: 6 cases, of which 5 were asymptomatic, while the sixth gave a history of a nondisabling chronic bronchitis.

Bronchiectasis and basal fibrosis: 3 cases of bronchiectasis and 6 of asymptomatic fibrosis.

Pulmonary coccidioidomycosis: 1 arrested case, contracted in the San Joaquin Valley.

Hilar adenopathy other than calcified lymph nodes: 1 case unchanged since induction a year and a half earlier and 1 case suggestive of Boeck's sarcoid.

Miscellaneous findings included a large non-toxic substernal thyroid, a calcified pleural plaque, and 2 cases of organized interlobar exudate.

HENRY K. TAYLOR, M.D.

Community Organization for Mass Chest X-Ray Surveys. A Plan in Operation in Delaware County, Pennsylvania. J. W. Cutler, A. M. Sharpe, J. W. Wood, and R. W. Bernhardt. Am. Rev. Tuberc. **53:** 224–239, March 1946.

Experience has shown that the only satisfactory method of finding undiagnosed cases of pulmonary tuberculosis consists in making roentgenograms of the chest of every person in the community and repeating the process at intervals. The present paper describes the development of a co-operative case-finding program in Delaware County, Pennsylvania. As is essential, the private physician is the backbone of the movement. The name of the family doctor, designated by the patient at the time of the survey, becomes a part of the survey record and x-ray reports are sent only to him.

A Chest Survey Committee is made up of 12 members, as follows: Two representatives each from the county medical society, the voluntary tuberculosis association, and the Department of Health, and one each from the general public, labor, industry, schools, health and welfare agencies, and hospitals and sanatoria. The main functions of this committee are to establish harmony of purpose, develop community co-operation, avoid duplication of effort, and direct the case-finding program along progressive and scientific lines. The interpretations are made only by qualified roentgenologists, phthisiologists, or experienced public health physicians. This is essential in order to maintain a high standard of quality of x-ray reports. The following types of reports are sent to the family physician: (1) negative or normal; (2) healed primary tuberculosis; (3) questionable disease, further supervision and study indicated; (4) minimal disease, probably tuberculosis; (5) advanced disease, probably tuberculosis; (6) significant findings other than tuberculosis, supervision and study indicated. Each report indicates the necessary steps that should be taken for further study of the patient.

L. W. PAUL, M.D.

The St. Louis County Tuberculosis Survey. Roberts Davies, G. A. Hedberg, and Mario Fischer. Am. Rev. Tuberc. **53:** 240–249, March 1946.

The methods used in conducting a tuberculosis survey of the whole population of St. Louis County, Minnesota, are described. The policy-making committee for the survey was made up of members from the state and local departments of health, the county medical society, tuberculosis associations, etc. Every effort was made to have the community assume the responsibility and the credit for success of the survey. A mobile photofluorographic unit was used, and a report on every film was sent to the individual's own physician.

In one year of operation 34,054 persons were examined, of whom 579 showed lesions considered to be significant tuberculosis. Studies for activity were done at the Sanatorium only if there were suggestive symptoms, x-ray evidence of exudative lesions or cavitation, or tubercle bacilli in the sputum or gastric contents. Forty-two of the 579 persons with pre-

sumably tuberculous lesions were admitted for study; 30 were found to have active disease and 12 were discharged as inactive after a short period of observation. The cost of the survey for one year amounted to 56 cents per person examined, $33.07 per case of significant tuberculosis found, and $308.79 per definitely or suspiciously active case. L. W. PAUL, M.D.

Tuberculous Pleural Effusion. Daniel J. Feldman and Howard P. Lewis. M. Clin. North America **30:** 245–261, March 1946.

It is generally conceded that 80 per cent of pleural effusions in young persons are of tuberculous etiology, and for this reason even a small and transient effusion cannot be dismissed lightly when the cause is not obvious.

Fifty-nine patients (56 males, 3 females) with pleural effusion were studied at an Army Hospital by the authors. The ages varied from twenty to forty-seven, but only five of the group were over thirty. Many, when seen, were in the resolving stage of the disease, with only residual pleural exudate or pleural thickening of variable degree. In 39 patients the effusion was right-sided, in 18 left-sided, and in 2 bilateral. In 34 patients the onset of the illness was insidious, with mild prodromal complaints; in 16 an acute onset followed a period of prodromal symptoms; 9 cases had an acute fulminating onset with no significant prodromal symptoms. Total and differential blood counts failed to reveal any constant variation, regardless of the phase of the illness. The sedimentation rate was significantly elevated in 55 patients. Skin tests with purified protein derivative injected intracutaneously showed positive reactions to either the 0.00002 mg. or 0.005 mg. dose in 56 of 57 patients. Throat cultures were made in 36 cases, but no significant correlation of the findings with the clinical condition was observed. No significant increase in titer of cold agglutinins was noted either at the onset or during the course of the illness in the 23 patients examined. Cultures and smears of the pleural fluid for pyogenic organisms were negative in all instances; smears of the centrifuged sediment failed to reveal tubercle bacilli. One positive sputum was found in the entire group, and this was positive by culture. Four patients were found to have tubercle bacilli in the gastric contents.

Chest roentgenograms of each patient were taken serially throughout the period of observation. The changes preceding and following the acute phase of the pleural effusion were of special interest. A notable thickening of the pleural membranes was observed in nearly all cases in which the fluid had not been evacuated and was allowed to absorb. When air had been introduced and the effusion was not subsequently removed, chronic localized areas of hydropneumothorax persisted, often for months. The initial pleural thickening, often as much as 4 cm., had an appearance similar to that of a fibrinous coagulum. Extraordinarily slow absorption of these plaques took place, and in many of the patients the sedimentation rate remained elevated during most of the time required for organization. Those patients whose fluid, when aspirated, showed a coagulum or a firm clot exhibited a high incidence of what was apparently a sudden and spontaneous clotting of the whole fluid mass in the pleural space. Organization and absorption of these coagula were exceedingly slow and almost always resulted in a fibrothorax. In 52 of the cases studied there was x-ray evidence of pleural thickening to a significant degree. Complete, uncomplicated resolution occurred in only 5 of the patients during the period of observation. The great majority of the films showed no evidence of parenchymal disease. Seven patients had exudative parenchymal lesions. Only 2 patients had discernible calcified areas.

A diagnosis of atypical pneumonia had been made in most of the patients in whom a significant parenchymal infiltration preceded the effusion. In many others the hazy density at the base, combined with the mild atelectatic changes in the adjacent lung and the common hilar swelling on the affected side, were thought to be due to pneumonia, and the effusion was believed to be a postpneumonic exudate. Enlargement of the hilar lymph nodes was seen frequently.

While only a small number of the patients in this series were proved to have tuberculosis by recovery of the organism, nevertheless, because of the marked similarity of the cases and the elimination of other possibilities, the authors are convinced that all of the cases were tuberculous.

As to the treatment, the authors believe that after the afebrile period has passed and reasonable stability in the effusion has occurred, ordinarily in two to three weeks, the fluid should be evacuated completely, in successive stages if necessary, depending upon the size of the effusion. By this procedure the coagulation of large effusions can be prevented and the marked fibrinous deposits on the pleural surface avoided. Since the complete removal of fluid results in approximation of the pleural surfaces and thereby fosters their adherence, it would seem desirable that a pneumothorax of at least 200 to 300 c.c. be induced initially. Adequate x-ray observation of the underlying lung may then be made and, if necessary, collapse therapy may be continued.

Massive Left Auricle, with Special Reference to Its Etiology and Mechanism. Report of a Case. Aaron E. Parsonnet, Arthur Bernstein, and Harrison S. Martland. Am. Heart J. **31:** 438–450, April 1946.

A 33-year-old white man died suddenly of rheumatic heart disease. He had had rheumatic fever at the age of eight and was subsequently told that his heart was affected, though he had no cardiac symptoms until the age of 29, in spite of undue physical exertion—frequent boxing bouts, long-distance running, etc. The first symptom referable to the heart was a short hacking cough. At 31 years of age, the patient began to experience dyspnea on slight exertion, and edema of the ankles appeared. He was hospitalized at various intervals after the appearance of symptoms and a diagnosis of rheumatic heart disease with massive left auricle was made. The authors do not mention roentgen examination in their record of the case, but films are reproduced showing extreme enlargement of the heart, with a transverse diameter of 30 cm. and a vertical diameter of 25.5 cm.

Following the patient's sudden death three years after the onset of symptoms, the heart was found to fill practically the entire chest. It contained over 2,000 c.c. of dark fluid blood, most of which was in the tremendously dilated left auricle, which measured 14 cm. in diameter. Empty, the heart weighed 1,600 gm. There was no evidence of predominant mitral stenosis, but the chief anatomic valvular lesion was a mitral insufficiency. Mitral insufficiency without an

accompanying mitral stenosis is rather unusual in rheumatic heart disease. The authors account for it in their case on the basis of an interstitial valvulitis due to the rheumatic process. This involvement did not produce stenosis, verrucae, shortening and fusion of chordae tendineae, fusion of the cusps, or calcification. It did, however, produce rubbery, curled, and puckered mitral leaflets which, together with a marked dilatation of the mitral ring, resulted in improper closure of the valve and mitral insufficiency. The imperfect closure of the mitral valve allows a certain amount of blood to regurgitate from the ventricle into the left auricle, so that at the end of auricular diastole this chamber contains not only blood which it has received from the lungs, but also that regurgitated from the left ventricle. This necessitates dilatation and, as increased work is required to expel the augmented contents, hypertrophy of the left auricle. In the case under discussion the rheumatic lesions were of greater severity in the left auricle than anywhere else in the heart, and once dilatation began, the condition of this chamber became progressively worse, until it was finally an enormous sac with very little contractility. "It is astonishing," the authors say, "how long such a patient may live before congestive failure sets in, but the whole sequence of events is slow and compensation is maintained by hypertrophy of both ventricles."

The fluoroscopic and roentgenographic findings in these cases are described as characteristic. The auricles, located in the right portion of the cardiac silhouette, form a "double-contour" shadow. In the right anterior oblique position the enlarged left auricle encroaches upon the mid-portion of the retrocardiac space. With the aid of a barium paste, displacement of the esophagus backward and to the right may be demonstrated.

HENRY K. TAYLOR, M.D.

Cardiac Enlargement in Fever Therapy Induced by Intravenous Injection of Typhoid Vaccine. H. Stephen Weens and Albert Heyman. Arch. Int. Med. **77:** 307–316, March 1946.

To determine whether cardiac enlargement occurs following the induction of fever therapy by intravenous injection of typhoid vaccine for neurosyphilis, teleroentgenograms of the heart were taken on 15 patients preceding fever, following each paroxysm, and several weeks after the completion of therapy. In each repeat examination special effort was made to obtain a roentgenogram with the diaphragm in a position comparable to that of the original film; when this was not possible, the patient was excluded from the study. Deep inspiration was avoided in order to eliminate an involuntary Valsalva effect. The size of the heart was determined in each roentgenogram by measuring the transverse diameter. Since normally the amplitude of the right border of the heart varies from 2 to 3 mm. and that of the left border from 3 to 5 mm., changes under 8 mm. were not considered significant.

Cardiac enlargement was found in 8 of the 15 cases, with increases in transverse diameter varying from 1.0 to 2.3 cm. In 2 patients there was an associated pulmonary congestion, and in 2 others small areas of atelectasis developed. In a second group of 24 patients, teleroentgenograms were obtained from three to twelve months after fever therapy and compared with those made before treatment. The heart was found to be larger in 4 patients, all of whom had had fever therapy within the preceding six months.

Electrocardiographic studies and determinations of cardiac output, blood proteins, and hemoglobin revealed no significant differences between the patients with and without cardiac enlargement. There appeared to be no relationship between increase in cardiac size and changes in blood volume. None of the factors known to influence cardiac size, such as anemia, nutritional deficiency, or overwork of the heart, was thought to be the sole cause of the enlargement.

The occurrence of cardiac enlargement following fever therapy is of interest not only in the treatment of neurosyphilis but also in the consideration of the effects of febrile illnesses on cardiac function. The use of fever therapy provides an opportunity to study these effects under controlled conditions, and suggestions as to further investigation of this problem are offered.

Dextrocardia in Association with a Short P-R Interval with Prolongation of the QRS Complex. Report of a Case. William D. Stubenbord. U. S. Nav. M. Bull. **46:** 412–416, March 1946.

A case of dextrocardia in conjunction with the syndrome of the short P-R interval and prolonged QRS complex in a 31-year-old sailor is presented. The combination of these two entities in the same person is a rare occurrence. There was also a transposition of the abdominal viscera. Despite these congenital anomalies, the patient was able to perform all his duties.

Clinical and Roentgenologic Diagnosis of Pericardial Effusion. Nathan M. Fenichel and Bernard S. Epstein. Ann. Int. Med. **24:** 401–412, March 1946.

The principal causes of massive pericardial effusion are rheumatic fever and tuberculosis. Lupus erythematosus disseminatus, pyogenic infections, malignant tumor, myxedema, and the terminal phase of cardiorenal failure are less frequent etiologic agents.

The most common complaint is precordial discomfort or a sense of weight substernally. Dyspnea may be distressing, and cyanosis of the face and distention of the neck veins are common. There may be some dysphagia, an irritative cough, and a somewhat anxious facies.

None of the clinical nor roentgenologic criteria is considered absolutely diagnostic. It is most difficult to make a clear differential diagnosis between cardiac dilatation and pericardial effusion, and the presence of basilar pulmonary opacities further complicates matters. The most reliable sign of pericardial effusion is the broad area of absolute cardiac dullness extending from the right midclavicular line to the left midaxillary line. Increased venous pressure is a constant finding, and a paradoxical pulse is frequently present.

The induction of hydropneumopericardium is a well established therapeutic procedure in tuberculous pericarditis. The authors have found it to be also a reliable aid in the diagnosis of pericardial effusions. Hydropneumopericardium presents a roentgenologic appearance which cannot be mistaken, and has the advantage of being equally positive in the presence of concomitant pleural effusions or other basal pulmonary disease. The fluid level is demonstrable within the pericardial sac, in the frontal and lateral projections, while fluoroscopic examination reveals the waves produced by the heart action.

The authors' series consisted of 13 patients with massive pericardial effusion. Six had rheumatic peri-

carditis, 2 had lupus erythematosus disseminatus, 2 had carcinomatous metastases, 2 had bacterial pericarditis, and 1 had cardiorenal failure. In all there was roentgen evidence of diffuse cardiac enlargement, but only 6 presented the so-called "water-bottle" configuration. The most reliable routine procedure was repeated observations for recession or progression in the size of the heart, which supplied positive information in 10 of the patients. Fluoroscopic studies were recorded in 7 cases. The difference in amplitude of pulsation over the heart margins and the great vessels was not considered definitely diagnostic.

Hydropericardium was induced in 5 cases, and in these the diagnosis was conclusive. The pericardial sac is preferably aspirated through the xiphoid area. The needle is inserted in the space between the ensiform cartilage and the left costal margin, and is directed backward, upward and toward the left, traversing considerable ligamentous tissue before entering the sagging pericardial sac. The usual practice is to aspirate as much fluid as is indicated by conditions present at the time, then to instill about 100 c.c. of filtered air, which is followed by roentgenologic examination.

Three illustrative cases are reported.

STEPHEN N. TAGER, M.D.

THE DIGESTIVE SYSTEM

Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula. Harry A. Keener and Robert C. Hickey. California & West. Med. **64:** 128–130, March 1946.

At a U. S. Naval Hospital the authors encountered 2 cases of congenital atresia of the esophagus with tracheo-esophageal fistula in 3,630 unselected deliveries over a period of twenty months. Vogt's classification is quoted: Group I: complete absence of the esophagus (very rare); Group II: blind ending of both upper and lower segments; Group III: esophagotracheal communication (between either the upper or lower segment of the esophagus and the trachea or between both esophageal segments and the trachea). In the authors' cases the communication was between the lower segment and the trachea.

The etiology of this condition is still unknown. The clinical picture is a classic one: regurgitation of food, drooling, coughing, dyspnea, and cyanosis. Passage of a rubber catheter usually reveals an obstruction about 12 cm. from the lips. Roentgenograms from the 2 cases reported are typical. With the aid of a radiopaque medium, the upper esophageal segment is outlined as a blind pouch. The presence of the fistulous communication with the trachea is indicated by air within the stomach and upper intestine.

Treatment is surgical, consisting in an attempt to ligate the fistula and anastomose the esophageal segments. The authors' patients, however, were regarded as such poor surgical risks that operation was not attempted. They died on the fourth and fifth days.

MAURICE D. SACHS, M.D.

Correlation of Gastroscopic, Roentgenologic, and Pathologic Findings in Diseases of the Stomach. An Analysis of 245 Proved Cases. Edward B. Benedict. Am. J. Roentgenol. **55:** 251–274, March 1946.

The author has used as the basis of this report 245 cases for which the roentgenologic, gastroscopic, and pathologic reports were available.

One hundred and twenty-five cases of proved gastric carcinoma are included. In the diagnosis of 67 cases roentgenology and gastroscopy proved equally good; in 3 cases doubtful results were obtained with both methods; in 3 cases both were wrong. In the remaining 52 cases a more accurate or more valuable report was given by the roentgenologist 32 times, by the gastroscopist 20 times. In 25 of the 32 cases where the roentgen ray was more valuable, gastroscopy failed to demonstrate the lesion at all. It is evident from an analysis of the cases that both methods of examination are important. Where one fails, the other may be successful. Besides being confirmatory or otherwise, gastroscopy may add secondary diagnoses, such as gastritis with or without erosions. The greater number of the gastroscopic failures could be attributed to mechanical difficulties.

Fifty cases of proved benign gastric ulcer were analyzed. In 16 cases the roentgen examination and gastroscopy were equally correct, and in 9 cases equally doubtful; in 21 cases roentgen examination was superior, and in 4 cases gastroscopy was superior. Gastroscopy was attended by the same mechanical difficulties as in the cancer series, which accounted for 17 of the 21 cases in which roentgen examination proved superior. These difficulties were met with chiefly in the prepyloric region and the lesser curvature of the antrum. It is disappointing to find how many ulcers were missed on gastroscopy, but their location is often in an area that is relatively blind.

Duodenal ulcer is of interest to the gastroscopist chiefly because of the gastritis which usually accompanies it, as the duodenum cannot be seen. A source of bleeding may be established when the ulcer is healed or quiescent. Twenty-five cases of duodenal ulcer were included in the series, but few of these were recent, as gastroscopy is now done only for special indications in these cases. Among 8 cases of jejunal ulcer, there was none in which gastroscopy proved superior.

Studies have proved the ability of both the roentgenologist and gastroscopist to diagnose gastritis not only in association with ulcer or cancer but also as an independent entity. In the author's 16 cases, the two methods were equally poor on 2 occasions; gastroscopy was superior 9 times and roentgen examination twice. Gastroscopy has unquestioned superiority in differentiating the various types of gastritis.

In 7 cases of benign tumor the two methods of examination were equal in value; twice the roentgen ray was better and twice gastroscopy was better. We come closer to the correct diagnosis if both methods are used. In considering the 5 cases of lymphoma studied, it seems the best we can hope for is to suspect it occasionally. The diagnostic criteria to look for may be unusually thick rugae, very marked cobblestone mucosa, multiple erosions and ulcerations in various parts of the stomach at different times, with or without rigidity or a tumor. Both methods of examination were inconclusive in sarcoma and metastatic carcinoma.

Gastroscopy is indicated in gastric lesions where the diagnosis is in doubt. Patients with bleeding may have negative roentgen findings; gastroscopy may show severe gastritis with erosions and superficial ulcerations. The gastroscopist may be able to differentiate between a benign and malignant lesion and indicate the type of treatment to employ. Gastroscopy supplements the roentgen examination and is in no way competitive. Gastroscopists must strive to bring about improve-

ments in the gastroscope so that blind areas may be eliminated and biopsies easily taken.

CLARENCE E. WEAVER, M.D.

An Individual Method of Graduated Compression Applied to Radiologic Research in Organic Lesions of the Stomach and Duodenum (Early Cancer Excepted). R. Hickel. J. de radiol. et d'électrol. **27:** 10–19, 1946.

The author presents his experience of six years with a compression technic which he devised for study of the stomach and duodenum. He deals first with the arguments of those who contend that compression produces a false image, a distortion which leads one to describe as pathologic certain duodenal bulbs which would not be considered so but for the compression. He comments also upon a debate which has continued about the relative merits of the upright and prone positions. He attaches little significance to the mucosal relief pattern without compression as an adjunct measure.

The method employed is essentially that of the Holzknecht spoon, plus a spot-film device. The illustrations included are all of rather advanced lesions and it would seem that anything the author shows here can be seen nearly as well in non-compression films.

PERCY J. DELANO, M.D.

An Evaluation of Criteria Useful in the Differentiation of Benign and Malignant Lesions of the Stomach. Henry J. Tumen. Pennsylvania M. J. **49:** 609–614, March 1946.

Carcinoma of the stomach and benign peptic ulcer may so closely mimic each other that all available laboratory and roentgenologic aids may not be sufficient for a differential diagnosis.

The average age of onset of carcinoma of the stomach is about fifty-five; symptoms of duodenal ulcer usually appear between the ages of twenty and thirty, and benign gastric ulcer has its onset at about forty. Gastric ulcer on the basis of sclerotic change may, however, be encountered at sixty or seventy, and gastric cancer may be seen between twenty and thirty. The age of the patient is, therefore, at best merely suggestive of the diagnosis.

The occurrence of earlier attacks of pain of the same nature is strongly suggestive of a benign lesion, but it may be impossible for the patient to differentiate between the pain due to a beginning cancer and that from a previous benign ulcer. A long, continuous history of digestive discomfort suggests cancer rather than benign ulcer, as the latter is characterized by a tendency to spontaneous remissions.

Massive hemorrhage usually occurs from benign lesions, while the bleeding from cancer is characteristically of the slow, oozing type. It has been estimated, however, that from 5 to 15 per cent of massive gastric hemorrhages are attributable to cancer. In such cases occult blood is likely to be found in the stools for a considerable period after the acute episode.

Particular search should be made for supraclavicular, cervical, and axillary nodes and for carcinomatous implants along the anterior rectal wall (Blumer's shelf). Demonstration of nodes in these regions or of an epigastric mass are presumptive evidence of a malignant growth.

In carcinoma there is usually a reduction of free acid, sometimes to the point of complete anacidity. This is not an invariable occurrence, however, for normal or excessive amounts of free hydrochloric acid may be associated with cancer. A high acid level is almost always found with ulcer. It was formerly believed that alkalosis was also characteristic of ulcer but experience has proved that, while alkalosis is more common in benign obstruction, its presence is not a definite sign that no carcinoma exists.

Evidence of liver damage is indicative of metastases, but normal liver function does not mean that the gastric lesion is necessarily benign. Elevation of the blood phosphatase is highly suggestive of malignancy and metastatic spread.

About 25 per cent of all benign ulcers are on the middle half of the lesser curvature, and 80 per cent of the lesions in this location are benign. About 60 per cent of benign ulcers and 50 per cent of all carcinomas of the stomach occur in the prepyloric segment. Lesions of the greater curvature are almost always malignant.

The author believes that the size of the ulcer is of little diagnostic importance, but that its depth may furnish a clue, in that carcinoma rarely penetrates deeply. If it does, it shows other unmistakable evidence of malignancy. In the presence of a benign ulcer, the roentgenogram will usually show radiating folds of mucosa following a fairly normal pattern. In carcinoma, the folds are obliterated and the area appears nodular. An associated spastic contraction of the greater curvature opposite the lesion is strongly indicative of its benign nature. Finally, cancer rarely develops in a patient with an active duodenal ulcer.

The gastroscope is not infallible in the diagnosis of gastric lesions, since there are "blind" areas in the cardia and antrum. If an ulcer can be visualized gastroscopically, its benign or malignant nature can usually be determined. A benign ulcer is generally clean-cut; its edges are somewhat hyperemic, and it is covered by a pearly white membrane. A malignant ulcer is dirty in appearance; its edges are irregular, and areas of necrosis are seen.

Some cases defy diagnosis, and observation of the patient under a rigid ulcer regimen must be resorted to. Such observation may not be conclusive, however, and evidence of apparent healing may create a false sense of security. Repeated examinations should be made until healing is complete. JOSEPH T. DANZER, M.D.

Leiomyosarcoma of the Stomach, Its Roentgenologic and Gastroscopic Diagnosis and Its Possible Relation to Pernicious Anemia. Rudolf Schindler, Olov A. Blomquist, Harold L. Thompson, and Arthur M. Pettler. Surg., Gynec. & Obst. **82:** 239–252, March 1946.

Leiomyosarcoma has been considered one of the rarest tumors of the stomach, comprising approximately 0.1 per cent of all malignant gastric lesions. The authors, having seen 4 cases within a relatively brief period, and having collected 94 cases from the literature, believe it may be more common than this figure would indicate. Its diagnosis is particularly important because of the favorable surgical prognosis.

Differentiation of leiomyosarcoma from benign leiomyoma is not easy, even on pathologic examination. Tumors apparently benign, microscopically, have been known to metastasize. Malignant tumors, on the other hand, may not form metastases for a long time, but they quickly break through their natural boundaries, growing expansively and in part infiltra-

tively. Infiltration is never of so high a degree as in infiltrative carcinoma and seldom as diffuse as in lymphosarcoma. Since the latter responds to radiation, while leiomyosarcoma is relatively radioresistant, their distinction is of primary importance. Grossly leiomyosarcoma may (1) grow into the gastric lumen and even become pedunculated, (2) expand within the gastric wall, or (3) grow into the omentum and adjoining structures. Ulceration of the overlying mucosa is a frequent finding.

The cardinal clinical manifestations are gastrointestinal hemorrhage leading to anemia, epigastric or left upper quadrant pain, and an upper abdominal mass. X-ray examination and gastroscopy should at least reveal the presence of a tumor. The findings in each of the present series are described in some detail. In one case the diagnosis of a gastric tumor was missed at one x-ray examination and in one at two x-ray examinations: in both cases the tumor was seen gastroscopically and could be demonstrated on repeat x-ray examination by the relief method. Reviewing their cases, the authors come to the conclusion that in 3 of the 4 the x-ray diagnosis of a submucosal tumor would not have been entirely impossible. While it must be admitted that in some cases the differentiation from carcinoma roentgenologically is impossible, the x-ray syndrome of filling defect, plus central niche, plus fistulas (into the tumor) should be considered as highly suggestive of leiomyosarcoma. In no instance was a correct gastroscopic diagnosis made, though in retrospect is is believed that this, too, should have been possible in 3 cases.

In the collected series, x-ray examination revealed a filling defect in 59 per cent, an extrinsic mass was suspected in 18 per cent, stiffness of the gastric wall was observed in 11 per cent, an ulcer niche without filling defect in 8 per cent. In 4 per cent a negative gastrointestinal series was reported. In one case the correct diagnosis of leiomyosarcoma was made (Chaffin: West. J. Surg. **46:** 513, 1938).

Leiomyosarcoma can be cured surgically in a high percentage of cases. Three of the authors' 4 patients are alive and well despite the size of the lesions. The fourth died postoperatively. The entire tumor must be removed, including adjacent involved organs.

A brief discussion of the relation between leiomyosarcoma and pernicious anemia is included. In one case it is suggested that a pernicious anemia may have been the primary condition, leading to the formation of the tumor.

Excellent roentgen illustrations are included.

JAMES C. KATTERJOHN, M.D.

Gastroduodenal Invagination Due to a Submucous Lipoma of the Stomach. William H. Hobbs and Samuel E. Cohen. Am. J. Surg. **71:** 505–518, April 1946.

The authors' patient was a 61-year-old white woman who had known of the presence of a movable, nontender mass above her umbilicus for the past year. Following a severe attack of vomiting without constipation, examination showed a movable epigastric mass measuring about 3 × 5 cm. Roentgenograms showed lack of filling of the antrum. Barium was retained in the upper half of the stomach and there was almost complete obstruction involving the lower half, giving rise to the "abrupt sign," described below. There was almost complete retention at six hours and 50 per cent retention at forty-eight hours. At operation, two-thirds of the stomach was found invaginated into the duodenum as far as the ligament of Treitz with the tumor at the head of the intussusception. Reduction was effected by traction, and a pedunculated intragastric tumor, 8 × 6 × 5 cm., was found attached to the posterior wall of the stomach. The tumor was resected and proved to be a lipoma. The patient made a good recovery.

Invaginations involving the stomach are the least frequent of intussusceptions in the bowel. The cause is practically always a gastric tumor, usually benign, which, as it is carried forward by peristalsis, pulls the stomach after it.

The authors have collected 41 reports of gastric or gastroduodenal intussusception [some apparently including more than one case]. On this basis they classify intussusception (1) as complete or partial, depending upon whether the entire thickness of the stomach wall or only the mucosa or the tumor is involved; (2) central or lateral, according to whether or not the whole circumference of the stomach is pulled through symmetrically; (3) due to an internal or external mechanism (cases in which the proximal or oral segment ensheaths the distal segment being considered as dependent upon an external mechanism); (4) grades I, II, III, and IV, depending upon the portion of the duodenum reached by the apex of the invaginatum.

The early symptoms are those of benign gastric tumor. Gallbladder disease may be simulated when the ampulla of Vater is occluded by the tumor or the invaginatum. Late symptoms are those of acute obstruction. A ball-valve syndrome due to sudden obstruction of the pylorus consists of violent and transitory attacks of vomiting and pain.

The early roentgen findings suggestive of benign tumor of the stomach are: (1) a circumscribed filling defect involving the walls rather than the curvatures; (2) obliteration of the rugae in the immediate area of the tumor; (3) normal peristalsis and no retention except with a lesion near the pylorus; (4) absence of niche, incisura or other signs of spasm; (5) close and complete approximation of the walls of the barium-filled stomach. Indicative of invagination are (1) a radiolucent area in the bulb; (2) convergent axial striations due to tension on the proximal part of the stomach; (3) parallel transverse striations due to barium in the lumen of the intussuscipiens; (4) the so-called "abrupt sign"—a sharp delineation of the contrast medium running approximately across the middle of the stomach.

The literature on benign gastric tumors is reviewed, emphasizing their rarity and the fact that lipomas represent only 3 to 5 per cent of the total.

J. L. BOYER, M.D.

Complete Duodenal Obstruction in the Newborn. N. Frederick Hicken, Spencer Snow, Q. B. Coray, and E. J. Jackson. Am. J. Surg. **71:** 461–469, April 1946.

The authors report 5 cases of duodenal obstruction in the newborn, with a plea for early surgical intervention. A general discussion of etiology, diagnosis, and treatment is given.

The obstruction may be (1) intrinsic, due to failure of the primitive ectoderm in the cord stage to become tubulated, or (2) extrinsic, due to bands, pressure from an overlying high cecum, or faulty fixation or

malrotation of the mesentery. Vomiting, beginning shortly after the child receives its first feeding, is the cardinal symptom. If, as is usually the case, the obstruction is below the ampulla of Vater, the vomitus is bile-stained and the meconium is acholic. With supra-ampullary obstruction, bile is not present in the vomitus but in the meconium. Epigastric distention invariably occurs. Dehydration, inanition, avitaminosis, etc., are rapidly progressive.

Diagnosis rests on the roentgen findings. Gas is present in the stomach only, unless an enema has been given, in which event there may be gas in the colon also. The authors advise anteroposterior and anterolateral films with the child inverted and upright. If the gastric gas bubble does not change position with changing posture, a fixed congenital deformity may be assumed. The duodenum may rupture neonatally and allow meconium to escape into the peritoneal cavity. Calcium present in the meconium may then be demonstrable roentgenographically. If barium is used in the examination, caution must be exercised to prevent its aspiration. It may be injected through a small Levine tube and removed by gentle gastric lavage after the roentgen study is completed. The barium clearly delineates the dilated stomach and duodenum, thereby localizing the obstruction. Hypertrophic pyloric stenosis may be differentiated from complete duodenal obstruction by the passage of small amounts of contrast medium into the jejunum.

Acute duodenal obstruction in the newborn must be considered a surgical emergency, and operation should be performed at once, after adequate preparation. The primary object is to relieve the obstruction as quickly and as safely as possible. Major procedures such as gastrojejunostomy and cholecystogastrostomy may be required in cases of complete atresia. Occasionally all that is necessary is the division of compressing cicatricial bands.

Four of the authors' patients died. In retrospect, it is believed that 3 of these might have been saved by earlier diagnosis and treatment.

JOHN A. COCKE, M.D.

Duplication of the Entire Large Intestine (Colon Duplex). Report of Case. Harry M. Weber and Claude F. Dixon. Am. J. Roentgenol. **55:** 319–324, March 1946.

The authors report a case of duplication of the large intestine in which the supernumerary intestine had no communication with the small intestine above it nor with the outside *via* the rectum. The supernumerary colon contained an opaque material (probably excreted calcium) and was visible roentgenographically. Its course ran parallel to the normal colon, lateral to the ascending and descending portions and above the transverse colon.

The patient was a woman aged twenty-seven who had been having attacks of sharp pain across the lower abdomen accompanied by obstipation. At the age of three she had been operated upon for obstruction of the intestine. The surgeon relieved what he called a "kink" in the region of the sigmoid flexure and created an opening into what he then thought was the colon but subsequently came to believe to be a mesenteric cyst. At nineteen years of age an operation was performed for acute appendicitis, at which time two appendices were removed, one of which was gangrenous. At twenty-two a surgeon explored the abdomen because of symptoms of obstruction and tried unsuccessfully to remove the supposed mesenteric cyst. The patient was also found to have a double uterus and double cervix.

After a roentgen diagnosis was made by the authors, surgical exploration revealed complete duplication of the large intestine. There was a large distended blind end in the left side of the pelvis. This displaced the rectum well to the right. The descending and sigmoid portions of both colons were resected for an extent of 8 to 10 inches. A second operation was done later to re-establish the continuity of the two colons by end-to-end anastomosis, producing a colocolostomy in the mid-sigmoid. Eight months after the first operation was performed, the patient had only minor abdominal distress. Roentgenograms revealed no opaque material in the colon and only small collections of gas along its course.

CLARENCE E. WEAVER, M.D.

Redundancy of the Colon. Arnold Galambos and Wilhelmina M. Galambos. Am. J. Digest. Dis. **13:** 87–101, March 1946.

Kantor's definition of the redundant colon is, "one which is too long to fit into the body of its owner without reduplication." Redundancy refers exclusively to the *length* of the colon. Megacolon refers to an increase in its width. Both may be present at the same time in varying degrees.

Some authors believe that redundancy is relatively infrequent. Moeller reports its presence in 2.4 per cent of 744 cases "of gastro-intestinal import." Others have recorded a much higher incidence. Redundancy is not a disease of the atonic or hypotonic state, as the redundant loops show no sign of stretching or thinning of the wall. It may exist in varying degrees without symptoms.

The diagnosis is a roentgenologic problem and may be established by what the authors call a three-phase method. First, a *scout film* of the abdomen is taken, which may show a pocket of gas-filled bowel far away from the suspected course of the colon, most frequently in the left splenic flexure or subdiaphragmatic region. Gas may fill the stomach and colon even though no redundancy is present, and a redundant loop may not necessarily contain gas. The *barium enema* study is the second and most important phase of the roentgen examination. This will show the size and shape of the colon and reveal the redundancy if present. For the third or functional phase the *barium meal* is employed. Where the motor mechanism is normal, the barium will pass through the intestinal canal, leaving the redundant loops without a sign of their existence. If, however, there is a breakdown in the motor mechanism, evacuation will be incomplete and gas and barium will remain in the redundant loops.

As Carman pointed out, "certain types of frame-structures are consistently associated with definite types of visceral topography, just as facial characteristics distinguish races." Thus, in the asthenic person, all viscera exhibit signs of drooping or ptosis, and this must not be confused with redundancy. Megacolon and megasigmoid must also be differentiated.

The redundant colon requires as its basic precondition an elongated mesentery, and in repeated examinations the colon will assume many bizarre configurations. Failure of a loop of bowel to move on several examinations suggests that adhesions are present.

The redundant colon is probably symptomless and goes undiagnosed in the majority of cases. Constipation is said to be present in 70 per cent of cases, but the authors found it no more distressing than, for example, in an average case of neurosis without redundancy. If symptoms occur, they are due to a kink, knuckle or ptosis of some of the loops. The pain becomes severe only when the motor mechanism is faulty. Most of the authors' patients had had at least one abdominal operation, appendectomy being the most common.

The most important problem in connection with redundancy of the colon is the ascertainment of whether or not the case is well compensated, or is one with impending or actually existing failure of motor mechanism. The breakdown in muscular compensatory mechanism will result in partial retention of both fecal matter and gases. Gas retention may result from failure of its transport or of its absorption, or it may be newly formed in the stagnating and decomposed fecal material in the redundant loops. Failure to correct by medical measures the damages wrought by this chronic development may necessitate surgical intervention, especially in progressive cases.

JOSEPH T. DANZER, M.D.

Volvulus of the Sigmoid Colon. Harold E. Simon, H. R. Senturia, and Thomas B. Keller. Am. J. Surg. **71:** 550–552, April 1946.

A case of volvulus of the sigmoid colon in a young man is reported, the interesting feature of the case being the complaint of backache without abdominal pain, tenderness, or distention. During the year previous to operation the patient had several episodes of intermittent low back pain associated with painful and ineffectual desire to defecate, probably representing episodes of partial or temporary obstruction. He entered the hospital following an attack of such severity that it awakened him at night. Peristalsis was normal and there was no abdominal tenderness or rigidity. Roentgenograms showed a hugely dilated loop of large bowel in the mid-abdomen, with a fluid level. A barium enema study showed rapid tapering of the rectum to a constriction, with torsion of the rugal folds and filling of a tremendously dilated loop of sigmoid above the constriction.

Operation revealed a twisted loop of sigmoid with a long mesentery. The loop of sigmoid was successfully resected.

J. L. BOYER, M.D.

Volvulus and Gangrene of the Sigmoid Complicated by Manson's Schistosomiasis. Meyer Corff. Pennsylvania M. J. **49:** 632–636, March 1946.

A diagnosis of volvulus of the sigmoid, in a 20-year-old Puerto Rican male, was made preoperatively by roentgen examination. At operation, the sigmoid loop was found to be gangrenous, more markedly so at the base of each arm where the volvulus had occurred, and a Paul-Mikulicz type of resection was done. A long redundant loop of the sigmoid (60 cm.) with a very short mesentery at the base (10 cm.) was thought to have been the probable cause of the volvulus. Microscopic examination of the specimen of bowel removed showed the wall, some of the blood vessels, and the lymph nodes to be infested with *Schistosoma mansoni*. Typical lateral spiked ova were found embedded in foreign-body giant cells, and the question arises as to whether or not irritation of the bowel by the *Schistosoma*, causing excessive peristalsis, may not also have been an etiologic factor in producing the volvulus. It was felt that this was possible but unlikely. Following completion of the surgery and treatment of the schistosomiasis with fuadin, the patient returned to duty in good condition, approximately four months after the initial operation.

Papilloma of the Gallbladder. David Miller. New England J. Med. **234:** 473–476, April 4, 1946.

Papilloma of the gallbladder is an uncommon finding and is usually discovered by the radiologist. It takes the form of a small, soft projection from the wall of the gallbladder, composed of branching complex processes of thin stroma covered by columnar cells. It does not seem to bear any relation to carcinoma of the gallbladder. A combination of infection and metabolic disturbance may play an etiologic role.

The symptoms of papilloma are similar to those of chronic cholecystitis and are most commonly encountered in the third decade. Roentgenologically the lesion is demonstrable as a small, discrete, constant radiolucent area within the gallbladder. It rarely is found in the fundus, where stones and adenoma are usually seen. Treatment is surgical.

Three complete case histories are presented.

JOHN B. MCANENY, M.D.

THE DIAPHRAGM

Acute Primary Diaphragmitis (Hedblom's Syndrome). Minas Joannides. Dis. of Chest **12:** 89–110, March-April 1946.

Acute primary diaphragmitis or Hedblom's syndrome is an acute primary myositis of the diaphragm manifested by inspiratory pain on the affected side, limitation of mobility of the lower chest wall, and a tendency to flaring of the costal margin with inspiration. There may be pain in the upper abdominal quadrant and in the homolateral shoulder and trapezius ridge. Roentgen examination shows an elevation of the involved leaf of the diaphragm, with restriction or absence of mobility. With healing, the dome of the diaphragm becomes flattened, and mobility returns. During the course of the disease there may be extension of the inflammatory process to the pleura or to the subphrenic area.

The author has observed 42 cases. Five case histories with illustrations are included in this article. In the differential diagnosis, the following are to be considered: acute spontaneous pneumothorax; acute "surgical abdomen"; basal pneumonitis; pleurodynia; intercostal herpes zoster; intercostal neuralgia; artificial or spontaneous pneumoperitoneum; irritation of the phrenic nerve trunk associated with mediastinal disease; the "scalenus syndrome"; acute spasm of the diaphragm; pulmonary atelectasis.

HENRY K. TAYLOR, M.D.

Right-Sided Transient Paralysis of the Diaphragm in a Newborn Infant. Case Report. J. Victor Greenebaum and Forest G. Harper. J. Pediat. **28:** 483–487, April 1946.

A case of transient paralysis of the right side of the diaphragm due to so-called isolated phrenic nerve injury in a newborn infant is reported. Signs of respiratory distress and cyanosis appeared on the fourth day of life. Fluoroscopy on the seventh day showed that the baby was breathing with only the left side of the chest.

the right side being practically immobile. At each respiration the mediastinum moved in a to-and-fro direction as a result of the paradoxical or see-saw movement of the diaphragm—the left side going down with inspiration while the right side, although appearing to be relatively fixed, was raised a little. The heart was displaced to the left and downward by the mediastinal shift, but the contour was normal. The roentgenogram confirmed the elevation of the diaphragm, at the level of the fifth rib, on the right. The infant was placed on the right side to splint the injured nerve, oxygen was given continuously, and gavage feeding was instituted. The cyanosis and respiratory distress were relieved to a surprising extent. Roentgen-ray and fluoroscopic examination at eleven days of age showed a definite increase in the movement of the right diaphragm and better aeration of the right lung. Three days later it was possible to place the baby on the back and left side for an increasing length of time without respiratory distress. A third roentgen examination, on the sixteenth day, was practically normal and the patient was discharged in good condition on the twenty-sixth day. At the age of five months he was in excellent condition and breathed normally. This is the eighth recorded case of diaphragmatic paralysis without accompanying brachial paralysis.

THE SPLEEN

Diagnosis of Lacerated Spleen. Samuel Levine, Leon Solis-Cohen, and Ralph Goldsmith. Am. J. Surg. **71:** 396–400, March 1946.

Traumatic laceration of the spleen is a common and serious injury. Three types of bleeding may occur: (1) immediate massive hemorrhage, due to extensive rupture, (2) slow oozing from small splenic lacerations, and (3) delayed hemorrhage from intracapsular injury. Aside from the local physical signs (shock may be absent), a very significant symptom is pain in the left shoulder aggravated by deep respiration; this may be quite severe. It is due to irritation of the left diaphragm by hemorrhage beneath it.

A flat film of the abdomen in the supine position shows a characteristic triad of signs in most cases: (1) markedly distended stomach, (2) jagged, serrated greater curvature of the stomach, believed by the authors to be due to infiltration of blood along the gastrosplenic ligaments, and (3) obliteration of the splenic shadow, merging with the perisplenic hematoma. Where hemorrhage is massive, there may also be a depression of the transverse colon, separating it from the stomach.

The anatomy and surgical treatment are discussed. Two case reports, following sledding injuries in boys, are given, together with illustrations. The triad of roentgen signs above is not found in injuries to the liver and kidney.

JOHN A. COCKE, M.D.

THE MUSCULOSKELETAL SYSTEM

Lumbosacral Roentgenograms of One Hundred Soldiers. A Control Study. Murray M. Friedman, Frederick J. Fischer, and Robert E. Van Demark. Am. J. Roentgenol. **55:** 292–298, March 1946.

The material for this study consisted of 100 males between the ages of nineteen and thirty-nine years, who had never had backache or suffered any injury to the back. The roentgenograms comprised anteroposterior and lateral projections of the lower lumbar spine and sacrum, right and left semilateral projections with 30 to 45 degree rotation, and a view taken with the tube titled 30 degrees cephalad, through the sacrum and lumbosacral joint.

Defects of the neural arch of the lower lumbar spine are not uncommon. They consist of an interruption of the bone between the inferior and superior articular processes, the pars interarticularis. It is this that is the underlying lesion contributing to spondylolisthesis. Defects in the pars interarticularis were found in 6 per cent of the spines of the group studied. Four of these showed some degree of spondylolisthesis. One of these showed considerable changes of degenerative arthritis but there was absence of back pain. Figures obtained by others in surveys of various types are quoted.

Asymmetrical facets of the lumbosacral articulations were found in 39 per cent of the group. In only 3 spines were the facets markedly asymmetrical. No evidence of arthritic changes was found about the facets in any instance.

Some degree of narrowing of the lumbosacral joint space was found in 11 of the 100 spines examined. This was marked in only 2 instances. Narrowing of the lumbosacral joint space may be due to degenerative changes in the disk structures and cartilage, herniation of the nucleus pulposus, or disintegration of the annulus fibrosus. Narrowed disk spaces are sometimes found with transitional vertebrae and present themselves as thin sacral disks. Schmorl's node was found in 8 spines.

Marginal bony proliferation of adjacent vertebral borders and osteophyte formation characteristic of osteoarthritis were found in 4 spines. Persistent ossification centers of the inferior articular process were found in 2 instances. As a rule, these are bilateral and are not to be interpreted as fracture. Eleven examples of transitional type vertebrae were found. In general, the role of a long transverse process impinging on the sacrum or ilium as the cause of backache is open to question.

The incidence of spina bifida occulta was 36 per cent in this group of 100 cases.

CLARENCE E. WEAVER, M.D.

Spondylolisthesis. Criteria for More Accurate Diagnosis of True Anterior Slip of the Involved Vertebral Segment. L. H. Garland and S. F. Thomas. Am. J. Roentgenol. **55:** 275–291, March 1946.

The cause of the forward slipping of a vertebral segment is presumed to be the normal stress of weight of the body, in some instances combined with occupational strains, trauma, weakening of muscles and ligaments from age or disease, and softening of some of these structures from pregnancy—all in the presence of a defective neural arch. To demonstrate a true slip requires a correctly positioned and exposed lateral roentgenogram of the lumbosacral spine, sometimes in the erect as well as the horizontal position. Oblique views are required to show the defects in the interarticular portions of the neural arch, the angle varying from 35° to 50°.

Examination of roentgenograms of the lumbosacral spine of many hundreds of patients in naval hospitals discloses the fact that a small but significant percentage of persons have a foreshortened fifth lumbar body. The posterior margin of this vertebral body may be

slightly forward, but its anterior margin is not displaced. The authors state that this is not to be regarded as a true slip. To judge forward displacement of the fifth lumbar body they use a line drawn perpendicular to the upper surface of the sacrum, at its anterior superior margin. Normally the anterior inferior margin of the fifth lumbar body lies from 1 to 8 mm. behind this line. In any definite degree of spondylolisthesis, the anterior inferior margin of the displaced body always touches or lies in front of the line, in the authors' experience. In a few cases certain anatomical variations and defects may render the establishment of this line difficult or impossible.

In a review of 170 consecutive lumbosacral roentgen examinations, a potentially significant foreshortening of the last lumbar segments was found in 25, or 14.7 per cent. In 15 of these no neural arch defects were present, but the posterior edge of the last lumbar body lay from 1 to 3 mm. ventral to the plane of that of the first sacral. In the other 9, arch defects were present, but in only 4 was the anterior margin of the fifth lumbar body ventral to the test line.

It may be stated that, in general, if the fifth lumbar body is normally "rectangular" in shape, and proportionate in size to its adjacent segments, there is a slip only when its anterior margin reaches or passes the perpendicular test line drawn from the first sacral. If the fifth lumbar body is foreshortened (especially caudally), and its shape in lateral projection is hatchet-like, the relation of its posterior margin to that of the first sacral segment cannot be relied upon for the detection of slip.

Neural arch defects were present in 11.7 per cent of the entire series of 170 cases referred for lumbosacral spine examinations. Eighty per cent of cases of spondylolisthesis involve the fifth lumbar body; most of the remaining 20 per cent involve the fourth. In 95 per cent of true olistheses the arch defects are bilateral. CLARENCE E. WEAVER, M.D.

Spondylitis Ankylopoietica. L. J. A. Parr and Eva Shipton. M. J. Australia **1**: 277–290, March 2, 1946.

This long paper on spondylitis ankylopoietica, known also by such names as Marie-Strümpell arthritis, von Bechterew's spondylitis, and spondylitis rhizomélique, reviews the literature and reports a study of a personal series of cases, covering all phases of the disease including roentgen diagnosis and radiotherapy. In the American literature the authors have found some confusion of this disease with rheumatoid arthritis of the spine, which is a different clinical entity. Gilbert Scott used the term adolescent spondylitis, since he believed that the pathological process which causes the condition always begins in early adult life, though symptoms may be delayed until late middle age.

Pathological studies on this condition are somewhat limited. The current view seems to be that the disease begins in the apophyseal joints, whereas Scott stressed the initial involvement of the sacroiliac joints, at least from a radiographic point of view. Most of the cases studied exhibit the final phases of the disease, with bony ankylosis of both the sacroiliac and apophyseal joints, calcification of the anterior and posterior longitudinal ligaments and of the ligamentum flavum, decalcification of the vertebrae, and in some instances extension to the shoulder and hip joints.

So far there has been no definite etiology established for this disease. The fairly frequent occurrence of an associated iritis (in Europe) is suggestive of a tuberculous origin in some cases. Not infrequently there is a history of a gonorrheal infection. Some authors recognize two types of the condition: one of slowly developing insidious onset and the other a more rapidly progressive or fulminating type almost invariably associated with a generalized infection. All stress the fact that the disease attacks vigorous, healthy young people, with a high predominance of males.

In the typical case there is a "prespondylitic" stage without definite localizing signs. The initial symptoms may closely resemble those of acute sciatica and in many cases sacroiliac involvement is masked by the pain along the distribution of the sciatic nerve. The pain in the lumbar region may radiate down the back of both thighs as far as the knees and such a distribution in a young man or woman should immediately raise the question of ankylosing spondylitis. Morning stiffness which disappears on arising and moving around but which may recur if rest is taken during the day is another common symptom. In the second stage of the disease the four cardinal symptoms and signs are rigidity, deformity, affection of the root articulations, and sensory and motor changes due to pressure on a nerve root.

Investigation of the serum calcium content shows very little deviation from the normal, even in the presence of pronounced decalcification. Scott regarded the decalcification which is present as a purely local phenomenon, in contrast to the generalized decalcification seen in rheumatoid arthritis.

The ankylosis may be either fibrous or bony. The fibrous state may remain for a variable period of years before bony union occurs. The most valuable test to gauge the activity of the condition is estimation of the blood sedimentation rate, which generally parallels the severity and stage of the disease.

The diagnosis of advanced disease is almost immediately apparent radiologically. The chief interest lies in determination of the site of initial involvement. The authors quote Oppenheimer, Scott, and others in this connection. Their own conclusion is that, although the x-ray appearance makes possible verification of the clinical diagnosis and may partially reveal the degree of involvement, absence of positive radiographic evidence in the early stages of the disease should not be regarded as disproving its presence. The clinical evidence, stiffness of the back and difficulty of motion, with limitation of some of the back motions, is of more significance than the lack of radiological evidence.

The differential features distinguishing spondylitis ankylopoietica from hypertrophic arthritis of the spine, spondylitis associated with inflammatory and infectious diseases, spondylolisthesis and Kummel's disease, postural deformity, primary or secondary malignant disease of the spine, Parkinson's disease, osteitis deformans, and tuberculous sacroiliitis are presented. The most serious error in diagnosis that can be made in the early stages of the disease is to confuse the symptoms of incipient spondylitis with those of tuberculous hip joint disease, leading to fixation of the pelvis and hip joints in a plaster cast with resultant ankylosis.

The treatment of ankylosing spondylitis is considered under several headings. Gilbert Scott's wide-field roentgen technic, which is quite different from ordinary deep x-ray therapy, is described. Scott subjected the whole trunk to irradiation from one direction at each

treatment, using 130 kv.p., 5 ma., 3 mm. Al filter, for a dose of 60 to 100 r, the distance from the tube to the patient being 17 to 20 inches. Treatment once or twice a week is usually required, with an interval of two or three weeks after ten to twelve treatments. The authors treated 38 cases by this method. Treatment was unsatisfactory in 2; 4 patients had relapses but responded to subsequent treatment; 32 showed improvement, in some cases amounting to apparent cure. Patience and persistence on the part of the doctor and the patient are essential for success. Some patients show rapid improvement after the first course of treatment even if the total dosage is less than 600 r; others require two, three, or even four courses.

BERNARD S. KALAYJIAN, M.D.

An Analysis of the Klippel-Feil Syndrome. C. A. Erskine. Arch. Path. **41:** 269–281, March 1946.

A case of Klippel-Feil syndrome is presented. The anatomic basis of this syndrome and its relation to Sprengel's deformity and to certain neurologic disorders is discussed, and a possible mechanism whereby such compound defects may take place is considered. It is concluded that the essential features of the cervical deformity are synostosis of two or more cervical vertebrae and flattening and widening of the vertebral bodies. A numerical reduction of the vertebrae is an incidental rather than an essential part of the disorder, as in spina bifida. The latter depends largely on the degree of abnormality of the vertebral bodies. There is evidence that the anomaly has a genetic basis. A number of pathologic conditions which have been found in association with the osseous deformity of the syndrome are explained in the light of recent observations in the field of experimental embryology.

Osteomyelitis in Infants. Robert A. J. Einstein and Colin G. Thomas, Jr. Am. J. Roentgenol. **55:** 299–314, March 1946.

Osteomyelitis in infants has its origin in the common respiratory diseases of infancy and in umbilical and skin infections. In the majority of cases the causative organism is the hemolytic streptococcus while *Staphylococcus aureus* is the next most common cause. Due to the more spongy texture of bone in infants and the thinner cortex, there is a freer communication between the marrow and the subperiosteal spaces. There is early and extensive periosteal elevation. The periosteum may rupture early, also, with the formation of soft-tissue abscesses. There is a minimum of bone destruction and sequestration is rare. Pyarthrosis is a common complication. In virulent infections, cartilage as well as the epiphysis is destroyed, with resultant deformities and arrest of growth. Metastatic involvement of other bones is common. Healing occurs rapidly after surgical or spontaneous decompression. Systemic manifestations are usually minimal in infants. Occasionally, however, there is a septicemia with severe systemic symptoms.

Treatment is general as well as local. Appropriate chemotherapy should be instituted. Any subperiosteal or soft-tissue abscess must be adequately drained. Immobilization is necessary. To diagnose pyarthrosis, aspiration of the joint is indicated. Development of chronic osteomyelitis is unusual. The mortality rate as given by different observers varies widely.

Roentgenologically the earliest finding is an area of bone destruction in the metaphysis adjoining the epiphyseal line. A similar area may be seen in the epiphysis. The periosteum of the diaphysis is elevated. Partial or complete epiphyseal separation indicates infection of the epiphyseal cartilage. Healing is evidenced by rapid subperiosteal formation of new bone. There may be delay in epiphyseal growth, with resulting deformities.

The authors report ten cases illustrating the various types of osteomyelitis in infants and include progress roentgenograms. Destruction of the epiphyseal cartilage, epiphyseal center, and cartilage of the joint seems to be the most common and most serious complication, as it is followed by disturbance in growth of endochondral bone, with ultimate deformity. A persisting sequestrum was seen in only one case. Clinical recovery in all cases was complete.

CLARENCE S. WEAVER, M.D.

Development of Squamous-Cell Carcinomata in the Sinus Tracts of Chronic Osteomyelitis. John J. Niebauer. J. Bone & Joint Surg. **28:** 280–285, April 1946.

That malignant change will occur in the sinus tract of a draining osteomyelitis has been known, but it is seldom encountered. The change is most frequently seen between the ages of forty and sixty, in patients who have had a draining sinus for twenty to fifty years.

Roentgenographic evidence of malignant change is lacking until the bone is invaded, when there may be destruction of the sclerotic bone. A positive diagnosis is made by biopsy, the section being taken from deep in the sinus tract.

Amputation is the best method of treating these complicated lesions.

Two case histories are presented, with reproductions of the radiographs and microscopic sections.

JOHN B. MCANENY, M.D.

Osteonephropathy: A Report of Two Cases. Boland Hughes and Gerhard J. Gislason. J. Urol. **55:** 330–341, April 1946.

In brief, the clinical picture of osteonephropathy, or "renal rickets," is that of a stunted and deformed child suffering rom diminished renal function and severe acidosis, with alteration of calcium and phosphorus metabolism. The bone changes may vary from marked deformities with the gross characteristics of infantile rickets to simple osteoporosis or osteomalacia. Almost all patients are retarded in growth. Urinary symptoms vary from polyuria to frank obstructive uropathies. Abnormalities of calcium and phosphorus metabolism are always present, the blood level of the former being low and of the latter high. Blood chemistry findings vary with the degree of renal insufficiency.

The exact underlying physiopathological relations between the various manifestations of this syndrome are little understood, but four hypotheses are given. The first postulates impaired ability of the kidneys to excrete the waste endogenous phosphates, which are then excreted through the intestinal mucosa, where they combine with ingested calcium preventing its absorption and thus causing a calcium, deficiency in the body, with bone damage. Overactivity of the parathyroid, possibly in conjunction with poor excretion of phosphorus, leading to an upset calcium-phosphorus balance, is another theory, but some observers deny the role of the parathyroid glands. A third view postulates

a pituitary-diencephalon lesion acting through the autonomic nervous system, and a fourth attributes the osseous changes to the prolonged acidosis from poor renal function. It may well be that these various factors overlap, thus producing the varied manifestations which are observed.

The classification of osteonephropathies proposed by Rule and Grollman (Ann. Int. Med. **20:** 63, 1944. Abst. in Radiology **43:** 312, 1944) is given. The most important group is that due to primary urinary tract disturbances, which includes renal disease with or without associated anatomical change.

Two case reports are given, representative of two types of osteonephropathy, one secondary to obstruction of the left upper urinary tract together with congenital absence of the right kidney, the other secondary to tubular disease of the hyperchloremic type.

It is emphasized that while the patient may present himself to various specialists, depending on which phase of the symptom complex predominates, the underlying pathology is renal.

ARTHUR W. PRYDE, M.D.

Osteoid Osteoma. Willis M. Weeden and Joseph J. Oliva. Am. J. Surg. **71:** 558–559, April 1946.

A case of osteoid osteoma arising from the middle third of the right ulna in a 27-year-old white male is presented. The lesion, first described by Jaffe, is believed to be a small, benign, slowly growing osteogenic tumor, composed of osteoid tissue which later becomes calcified and converted into hypercalcified atypical bone. This nidus of intramedullary osteoid tissue characteristically produces an excessive bone reaction about it. As it progresses, this sclerotic new bone formation may obscure the nidus on the roentgenogram. In the present case, the true nature of the condition was brought out by overexposing the film. Though the diagnosis is usually made roentgenographically, the condition should be suspected clinically in young adults presenting localized bone pain of some months' duration. Osteoid osteoma must be differentiated from bone abscess, chronic sclerosing non-suppurative osteomyelitis, osteoma, syphilitic osteoperiostitis, and early sclerosing osteogenic sarcoma.

JOHN H. FREED, M.D.

Sarcoid of Bone. Report of a Case. C. D. L. Cromar, D. R. Murphy, and C. M. Gardner. J. Bone & Joint Surg. **28:** 294–298, April 1946.

Sarcoid of bone is usually found in young adult males. It is of insidious onset, usually involving the bones of the hands and feet. Pain may be present in the early stages.

Three types are observed, showing (1) diffuse mottling or speckling of bone, with slight expansion of the cortex; (2) punched-out areas in the bone, suggesting cysts; (3) loss of bone density and a latticework appearance, without alteration of bone contour. Although many observers regard the disease as atypical tuberculosis, there is little direct evidence to support this belief.

Bone sarcoid must be differentiated from dactylitis tuberculosa, leprosy, syphilis, gout, and traumatic cysts. There is no specific treatment.

The present report concerns a soldier hospitalized in 1944 for an upper respiratory condition. He complained of a painful left wrist dating back to 1941 and an x-ray examination was made. The film revealed cyst-like areas in the triangular, greater multangular, and capitate, the distal end of the radius, and the proximal ends of the second and third metacarpals. Biopsy showed sarcoid tissue. JOHN B. MCANENY, M.D.

March Fractures of the Foot. Care and Management of 692 Patients. Abraham Bernstein, Marvin Childers, Maurice C. Archer, Kermit W. Fox, and Joseph R. Stone. Am. J. Surg. **71:** 355–362, March 1946.

The authors add to their 1944 report of 307 cases of march fracture of the foot (J. Bone & Joint Surg. **26:** 743, 1944. Abst. in Radiology **44:** 611, 1945) 692 further cases. Diagnostic criteria are (1) point tenderness over the dorsum of the involved metatarsal, (2) pain in the metatarsal area upon manipulation of the toe, (3) swelling, (4) limp, and (5) rarely crepitus. Early roentgenograms may fail to reveal a fracture line but periosteal thickening over the medial aspect of the distal and middle thirds of the metatarsal may be seen. Later a fracture may be apparent, and large amounts of callus on both sides of the shaft. Margins of the bone at the fracture site will appear hazy and indistinct. Extreme care must be taken in the interpretation of wet films, because it is here that these fractures are frequently missed.

Dodd's conception of a shortened metatarsal (congenitally) as a significant etiological factor is not substantiated by the authors. One hundred normal feet chosen at random were compared with the present series and no variation in the lengths was noted.

In the 692 cases studied 724 fractures were distributed as follows: 3d right 224, 2nd right 181, 3d left 150, 2nd left 138, 4th right 16, 4th left 9, 5th right 3, 1st right 2, and 5th left 1.

Details of treatment were discussed in the earlier article. In the new series 634 patients were treated while ambulatory and 58 had to be hospitalized. No one had been discharged for march fracture. It is interesting to note that the highest incidence of these fractures occurred in the sixth to tenth week of the training period. JAMES C. KATTERJOHN, M.D.

March Fracture of the Inferior Pubic Ramus. P. V McCarthy and R. E. Van Demark. Mil. Surgeon **98:** 233–235, March 1946.

During a period of less than a year the authors observed 4 cases of march fracture of the inferior pubic ramus; two of these cases, one with bilateral involvement, are recorded here.

GYNECOLOGY AND OBSTETRICS

Recurrent Placenta Previa and the Significance of Placentography as a Diagnostic Criterion. Monrad E. Aaberg. Am. J. Obst. & Gynec. **51:** 578–580, April 1946.

In a review of the literature the author found only 10 reported cases of recurrent placenta praevia in successive pregnancies and one case in non-successive pregnancies. He presents two new cases, one of each type. In the first case a marginal placenta praevia was present in the patient's first pregnancy, in 1940, and a complete placenta praevia in her third pregnancy, in 1943. In each instance, there was some vaginal bleeding, and in each placentography showed the placenta low on the posterior wall of the uterus. In the second

case placenta praevia was present in the patient's seventh and eighth pregnancies–marginal in the former and complete in the latter. The implantation was low on the anterior uterine wall.

The following criteria are offered as making possible a more accurate interpretation of soft-tissue films, facilitating an earlier diagnosis of placenta praevia. First, if the placenta cannot be visualized on the anterior or posterior uterine wall a diagnosis of complete placenta praevia should be made and confirmed by vaginal examination. Second, when the maximum thickness of the placenta is visualized at or below the equator of the uterus on the anterior uterine wall, it is very likely to be a placenta praevia. The likelihood of complete praevia increases proportionately with the distance of the maximum thickness of the placenta below the equator of the uterus. Third, when the placenta is visualized low on the posterior wall, displacing the presenting part 3 cm. or more from the tip of the sacral promontory or from the base of the fifth lumbar vertebra, a diagnosis of placenta praevia should be accepted and corroborated by vaginal examination.

In the author's clinic soft-tissue films are taken in all cases of vaginal bleeding during the last trimester of pregnancy, unless the patient is in shock from massive hemorrhage. When the placenta is visualized high in the fundus, routine vaginal examinations may be deemed unnecessary. When the placenta is perceived below the equator of the uterus or not seen at all, prompt vaginal examination in an operating room prepared for immediate cesarean section is essential to corroborate the diagnosis.

BERNARD S. KALAYJIAN, M. D.

Early Clinical and Roentgenologic Diagnosis of Anencephaly. Catherine W. Blumberg and George Teplick. Am. J. Obst. & Gynec. **51:** 571–574, April 1946.

Reported cases of anencephaly diagnosed before delivery and confirmed by x-ray examination are few in number. In most cases suspicion of the defect was not entertained until about the seventh month of gestation, at which time there was usually rapid enlargement of the uterus because of hydramnios. Fetal heart tones, as a rule, are absent or indistinct, which may be due in part to lack of innervation of the heart muscle; fetal movement is not felt subjectively or on palpation, and when movement does occur, it may be of the exaggerated spasmodic or convulsive type, accounting for complaints of abdominal pain, which are more common with this abnormality than in normal pregnancy.

The authors' patient was presumably in the fifth month of pregnancy when she was first examined, though the history was vague. She had felt no fetal movements and no fetal heart tones or uterine souffle could be heard. A roentgenogram at this time showed a fetus of four to four and a half months, with two small ossified knobs in place of a skull. The uterine shadow was well outlined and larger than to be expected with a fetus of this size, corroborating the clinical impression of hydramnios. Repeated films made several days later verified the diagnosis of anencephaly with hydramnios and showed surprising increase in the size of the uterus. Twelve days later the size was that of a seven months pregnancy. A few days after this the membranes were ruptured, uterine contractions occurred, and a macerated anencephalic fetus was extracted with some difficulty. It had a crown-rump length of 15 cm., representing about four and a half months' gestation.

In view of the fact that the fetal skeleton cannot usually be well demonstrated by roentgen rays until about the eighteenth week, it is believed that this case is one of the earliest to be diagnosed clinically and confirmed roentgenographically. The authors give a list of the cases of anencephaly reported as diagnosed by roentgen rays, numbering 18. [This list is by no means complete. Weiskotten, whose report of 3 cases is not mentioned, found 18 cases in the American literature as early as 1933 (Radiology **20:** 58, 1933) and a number of examples have since been reported.—Ed.]

BERNARD S. KALAYJIAN, M.D.

THE GENITO-URINARY TRACT

Experiences in Management of Congenital Anomaly of the Kidney in the Army. John H. Harrison and Thomas W. Botsford. J. Urol. **55:** 309–322, April 1946.

Seventy-two patients having congenital anomalies of the kidney were encountered among 28,918 admissions to a general hospital in the Southwest Pacific area. All had clinical symptoms leading to urologic investigation. The symptoms of congenital anomaly of the kidney are bizarre in nature and vary in severity. They are the result of disturbance of intrinsic renal function, interference with emptying of the pelvis and ureter, or abnormal anatomical location of the organ.

The various types of anomaly encountered are discussed in detail, with their treatment. The most frequent abnormality was reduplication of the renal pelvis and ureter, occurring in 35 patients. The next most frequent was congenital hydronephrosis, found in 21 patients, in most instances the result of aberrant blood vessels. There were 7 instances of unilateral hyperplastic kidney, and 5 of renal ectopia, in one of which there was associated duplication of ureter and pelvis. Polycystic disease and horseshoe kidney also were encountered. Roentgenograms of many cases are presented.

In general, renal lithiasis, pyelonephritis, and hydronephrosis were the conditions superimposed on the renal anomalies. The authors believe that when such conditions complicate a congenital anomaly, the men are unfit for tropical duty, as many cases showed exacerbations under the strenuous conditions of military service. Twenty-one of the present series required operation.

ARTHUR W. PRYDE, M.D.

Supernumerary Kidney with Ureter Opening into Vagina. Donald N. Headings and Rufus E. Palmer. Am. J. Surg. **71:** 370–373, March 1946.

Of 43 examples of supernumerary kidney collected from the literature, 5 were said to have extra-vesical ureteral openings. Only one of these five had been diagnosed preoperatively. The embryologic origin of these supernumerary kidneys is discussed and a case is reported.

The patient had noted leakage of clear fluid from the vagina since birth, but no other pertinent symptoms were present. By careful vaginal examination, a small orifice was noted near the external urinary meatus and this orifice discharged a colorless fluid resembling urine. The cervix was nulliparous and normal. The accessory kidney was not visualized by intravenous urography

but retrograde filling of the ureter disclosed a straight tube-like structure lying medial to the right ureter and ending in a blind pouch corresponding to the renal pelvis. Connection to the normal right ureter could not be demonstrated either with radiopaque material or methylene blue. Nephrectomy and complete ureterectomy of the accessory rudimentary kidney was successfully performed. JAMES C. KATTERJOHN, M.D.

Giant Hydronephrosis in a Duplicated Kidney. Philip M. Cornwell. J. Urol. **55:** 238–245, March 1946.

A case of giant hydronephrosis in a duplicated kidney, presenting several unusual features, is reported. The patient was a 67-year-old laborer, whose chief complaints were "fluid in the abdomen" and "shortness of breath." The present illness had started four years earlier, when the patient first noticed that his abdomen was increasing in size and he began to have periods of marked burning on urination associated with increased frequency and occasional chills and fever. Five weeks previously, he was admitted to another hospital in mild cardiac decompensation. There he was digitalized and given sedatives and mercurial diuretics. The swelling of the abdomen was thought to be due to ascites and a paracentesis was done, with removal of 6 quarts of foul-smelling, cloudy, greenish-yellow fluid. He was then transferred to the Wisconsin General Hospital, from which this report comes, for further treatment. Here, the huge abdominal mass was recognized as being within but not of the general peritoneal cavity. Because of slight changes in the blood picture, it was first thought to be a greatly enlarged spleen and the picture that of an aleukemic phase of lymphatic leukemia.

A flat x-ray film of the abdomen suggested, however, that the mass was not splenic in origin and renal studies were then done. Excretory urography revealed a normally functioning right kidney with a duplication of its pelvis and ureter, and absence of function of the left kidney. A retrograde pyelogram showed the left renal pelvis to be moderately dilated and displaced far laterally, with flattening of the calices. Barium studies showed the gastro-intestinal tract to be uninvolved except for marked displacement of the stomach and small bowel to the right and displacement of the descending colon laterally. In view of these findings, a diagnosis of a huge retroperitoneal cystic tumor, probably a giant hydronephrosis involving the upper half of a duplicated left renal pelvis, was made.

A retroperitoneal surgical exploration was advised and carried out after the patient's cardiovascular status had improved. At operation, the upper pole of the left kidney was found to consist of a huge cystic mass, measuring 22 cm. in its greatest dimension, with a ureter, dilated to the size of the small bowel, issuing from its lower portion. The lower pole consisted of a small flattened bit of normal-appearing renal tissue intimately connected with the large cystic structure but drained by a second ureter of approximately normal caliber. The left kidney and cystic mass were successfully removed. JOHN H. FREED, M.D.

Diverticular or Cavitary Chronic Prostatitis. Alfonso de la Pena and Emilio de la Pena. J. Urol. **55:** 273–277, March 1946.

Diverticular prostatitis is a type of chronic prostatitis with the formation of small abscesses that may rupture into the urethra, leaving cavities or diverticula with large openings communicating with the urethral canal. The symptoms of this condition are pyuria, hematuria, frequency, sexual disturbance, and pain along the urethra and perineum. Possible complications are intraprostatic, vesical, or renal stones and, rarely, ureteral backflow. Multiple openings from the prostate into the urethra can be seen on urethroscopic examination and pus can frequently be expressed from these on stripping of the gland. Large channels are often seen and with them a median bar due to associated fibrosis. If the openings are too small to be seen directly, they may be visualized by urethrocystography. Iodized oil will fill out the cavities, which appear on the film in the form of a bunch of grapes or as a single diverticulum with its duct draining into the urethra.

Both congenital and acquired diverticula occur. The former, which are seldom seen, are usually symmetrical, have a large, short outlet, and are often associated with other abnormalities, as spina bifida or patent urachus. Diverticula of the acquired type are of more interest. By retention of septic secretion they may act as a focus of infection. They may also cause bladder neck obstruction as a result of chronic prostatitis, in the final stage of which the prostate along with surrounding tissue becomes fibrotic and hard.

Diathermic destruction of the cavities through the urethroscope has been advised. The authors have used deep roentgen therapy over the last ten years, with good results in a small number of cases.

ARTHUR W. PRYDE, M.D.

Trauma of the Lower Urinary Tract. A Roentgenologic Study. H. Stephen Weens, J. Harold Newman, and Thomas J. Florence. New England J. Med. **234:** 357–364, March 14, 1946.

Injuries of the bladder and posterior urethra are surgical emergencies. The history and physical examination may be sufficient for a diagnosis. Intraperitoneal rupture of the bladder, however, may show grossly clear urine, and hematuria may occur without significant urinary tract injury. Recently, urethrography and cystography have been advised, but the correct interpretation has not been sufficiently stressed. For this reason, the authors present 7 cases with their observations and reproductions of their films. The cases are briefly as follows:

Case 1: Bloody urine obtained on catheterization. Intravenous pyelogram normal. Retrograde cystogram showed intraperitoneal extravasation.

Case 2: Fracture of the pelvis. Urine bloody. Intravenous pyelogram normal. Intraperitoneal extravasation demonstrable on retrograde cystogram.

Case 3: Fibrous contraction of the bladder neck, with retention relieved by catheter. An attempt at cystoscopy was unsatisfactory and the patient complained of abdominal pain. Rupture of the bladder was suspected and a retrograde cystogram showed intraperitoneal extravasation.

Case 4: Fractured pelvis. Bloody urine. A cystogram showed contrast medium in the pelvic tissues and exploration revealed a tear in the retropubic space.

Case 5: Fractured pelvis. Bloody urine. Extraperitoneal extravasation of the contrast medium demonstrable on retrograde cystogram.

Case 6: Pelvic fracture. Bloody urine. Extravasation in the region of the bladder neck demonstrated by retrograde cystography.

Case 7: Fracture of the pelvis. Bloody urine. Extravasation of the contrast medium in the region of the posterior urethra demonstrated by retrograde cystography.

As is seen in this series, intravenous pyelography, while it may produce a satisfactory cystogram, is not reliable for the demonstration of injury. The authors suggest retrograde cystography in all patients with possible lower urinary tract injury.

The procedure consists in injecting 20 per cent skiodan, or some other contrast medium, into the urethra with an Asepto syringe. A preliminary roentgenogram is made after the injection of a small quantity of contrast medium. If no abnormality is seen, the bladder is well distended.

In intraperitoneal rupture of the bladder, the distended intestinal loops present a characteristic appearance. More important is the band-like or linear spread of the medium along the peritoneal reflection of the flanks (paracolic recesses). A full view of the abdomen should be obtained. Rupture of the posterior urethra and extraperitoneal vesical rupture are characterized by diffuse penetration of the medium into the pelvic floor tissues and the prevesical space. In massive extravasations the medium may assume a sunburst-like appearance. Intraperitoneal and extraperitoneal rupture of the urinary bladder may occur but was not encountered in this series.

JOHN B. MCANENY, M.D.

THE SPINAL CORD

The Myelographic Diagnosis of Extramedullary Cervical Spinal Cord Tumors. Bernard S. Epstein and Leo M. Davidoff. Am. J. Roentgenol. **55:** 413–419, April 1946.

The roentgenologic diagnosis of spinal cord tumors has rested largely on the presence of pressure effects on the vertebrae. These changes are usually late manifestations. The use of pantopaque myelography permits the diagnosis of intraspinal tumor masses in the cervical canal before visible changes occur in the vertebrae. The authors report myelographic findings in 5 patients with extramedullary tumors of the cervical spinal cord or nerve roots in whom the routine roentgenograms were normal. In 3 of the cases the tumor was a perineurial fibroblastoma, and in the other 2 a psammomatous meningioma. The neurological findings were variable and did not permit exact localization of the level of the lesion.

In the technic described, a motor-driven tilt table, which may be tilted 10 degrees head downward, equipped for fluoroscopy and spot-film roentgenography is required. Three cubic centimeters of pantopaque is injected into the lumbar subarachnoid space. After the oil gathers in the lumbar sac, the head of the table is tilted downward 10 degrees from the horizontal, permitting the oil to ascend to about the 1st lumbar level. The patient then gradually assumes a knee-chest position until the pantopaque reaches the upper thoracic region, when he is returned to the prone position, the table is tilted slightly caudad, and the oil is allowed to collect in the lower cervical canal.

The diagnosis of cervical spinal canal tumors rests on the presence of filling defects in the advancing head of the pantopaque column. These may assume an arcuate or curvilinear configuration. The defect will be constant on repeated observations. In examination of the upper cervical spine, passage of pantopaque into the basilar cistern is likely to occur. Usually the oil can be returned to the spinal canal by reversing the patient's position. Two reactions have been noted in patients showing retained droplets of pantopaque in the basilar cistern. The first consisted of vertigo of four days' duration, starting one week after myelography. The second was a headache of two days' duration, starting five days after examination. Both patients had negative cervical myelograms.

H. H. WRIGHT, M.D.

THE BLOOD VESSELS

Clubbed Fingers. Robert Charr and Paul C. Swenson. Am. J. Roentgenol. **55:** 325–330, March 1946.

Roentgen studies were made in 6 cases of recent clubbing of the fingers without osteoarthropathy, with a view to demonstrating possible arterial changes. Post-mortem arteriograms in 3 cases, in which a mixture of barium and water was used as the contrast medium, showed that arteries and arterioles were more numerous, their lumens were wider, and the network of arterioles covering the ungual processes was heavier than normal. In 2 other cases infra-red photographs of the clubbed fingers also demonstrated increased prominence and number of the superficial vessels. The arteriograms and photographs are reproduced.

The prevailing impression seems to be that clubbing of the fingers is largely a hypertrophy and hyperplasia of the tissues about the terminal phalanges as a result of increased nutrition due to an enhanced peripheral blood flow.

Two of the authors' patients died of fibroid pulmonary tuberculosis and one of anthracosilicosis with superimposed tuberculosis; one was under treatment for advanced bronchiectasis, and one had congenital pulmonary stenosis. The sixth had pulmonary necrosis with erythema of the nail beds and palms and urticaria of the palms. CLARENCE E. WEAVER, M.D.

Calcified True Aneurism of Left Renal Artery. J. P. Brady and J. S. Hanten. Calif. & West. Med. **64:** 131–132, March 1946.

True calcified aneurysms of the renal artery are rare. To date 72 cases have been reported in the literature. The authors add a further example, in which pyelographic studies were made. An incomplete annular shadow was demonstrated near the hilus of the upper pole of the left kidney, and three possible diagnoses were suggested, in the following order of probability: calcified cyst, early new growth with calcified cyst, aneurysm of the renal artery. Because of the second possibility, nephrectomy was done, and two sacculated aneurysms of the renal artery were found. The larger of the two had a shell-like wall, partially calcified.

Special attention is called to the defect in the ring-like shadow of calcification, representing probably the connection between the aneurysm and the artery. A similar defect appears in films reproduced in other reports, and the author suggests that it may be of significance for the differential diagnosis. The form of the shadow, spherical and hollow, should aid in differentiation from calcified lymph nodes, and the fact that it may be shown stereoscopically to be external to the renal parenchyma should exclude a diagnosis of cyst.

MAURICE D. SACHS, M.D.

THE SOFT TISSUES

The Ehlers-Danlos Syndrome. John F. Holt. Am. J. Roentgenol. **55:** 420–426, April 1946.

The Ehlers-Danlos syndrome is a congenital dystrophic anomaly consisting of hyperelasticity and fragility of the skin and blood vessels, hypermobility of the joints, pseudo-tumors over the bony prominences, and movable nodules beneath the skin. It is frequently associated with other developmental anomalies. Its etiology is unknown. The subcutaneous nodules found in this condition have been described by some as consisting of a spherical, fibrous outer portion, possibly with a zone of calcification, and a fluid inner portion. Others describe the nodules as shot-like, oil-containing cysts surrounded by fibrous or calcified capsules.

The author reports the observation of disseminated soft-tissue calcium deposits in the extremities of two sisters presenting typical clinical signs of the syndrome. No previous roentgenograms illustrating the calcified subcutaneous nodules appear in the literature. In the first case, in a white girl aged 18, roentgenograms of all four extremities showed disseminated, small, rounded, discrete calcareous nodules involving either the skin or the immediate underlying tissues. In the upper extremities calcifications were most numerous on the extensor surfaces. Involvement of the thighs was limited chiefly to the extreme lateral surfaces. The calcifications were most numerous in the lower legs, with a predilection for the lateral and medial skin surfaces. The calcifications have a rather uniform appearance, usually with a central zone of relatively increased radiolucency, surrounded by a ring-like shadow of lime salt.

The younger sister, aged 16, was examined because of a tumor involving her left knee. Roentgenograms showed a primary malignant neoplasm of the proximal left tibia, and biopsy showed osteochondrosarcoma. Initial films, made for bone detail, did not show subcutaneous calcified nodules clearly. Subsequent roentgenograms of the surgical specimen, following amputation, showed calcified subcutaneous nodules, fewer in number but of the same configuration and distribution as noted in the previous case.

Microscopic examination of the subcutaneous nodules in the surgical specimen revealed that the majority of them contained no calcium deposits but consisted of isolated groups of fat cells tightly compressed within collagenous fibrous capsules. Most of the fat cells were necrotic, and it is within this tissue that calcium is deposited. Uniform increase in elastic tissue is seen in the corium.

Phleboliths occurring in hemangiomata show some resemblance to the calcified nodules seen in this condition, but are apt to be distributed throughout the deeper soft tissues and show more variation in size and irregularity in outline. The larvae of parasites which may calcify in the muscles of the extremities have peculiarities of shape which should permit differentiation. H. H. WRIGHT, M.D.

RADIOTHERAPY

Epithelioma. Report on 1,742 Treated Patients. Joseph A. Elliott and David G. Welton. Arch. Dermat. & Syph. **53:** 307–328, April 1946.

The material for this paper is drawn from a group of 2,081 patients seen in private practice in a twenty-two-year period. Excluding those with lesions of the mucous membrane, Paget's disease, and Bowen's disease, as well as those referred for high-voltage roentgen therapy and surgery and a small number who failed to return for treatment, the series analyzed consists of 1,742 patients with 1,928 epitheliomas.

Of 633 patients who were questioned on this point, 37 per cent gave a family history of cancer. With more accurate histories, this figure would probably be much higher.

The authors believe that almost all epitheliomas are preceded by some degenerative change, most of them developing from senile keratoses. They also discuss at length the etiologic role of sunlight, but do not regard their figures on this point as particularly significant, as many of those who were listed as having an indoor occupation (59.4 per cent of the total) actually spent much time out of doors.

The lesions observed are divided into three groups: small (less than 0.5 cm. in surface diameter), 45.6 per cent; medium (0.5 to 1.0 cm.), 26.4 per cent; large (over 1.0 cm.), 27.9 per cent. The size of the epithelioma was found to play a significant role in the results of treatment. Fifty per cent of the authors' failures were in lesions exceeding 5.0 cm. in diameter.

As to clinical form, 29.4 per cent are classified as papules; 25.6 per cent were nodules and tumors; 17.2 per cent superficial ulcers; 16.8 per cent deep ulcers, 7.2 per cent verrucous lesions, 3 per cent cutaneous horns and senile keratoses with malignant base. In 77.8 per cent the lesions occurred on the face.

Two hundred and ten of these cases (12 per cent) had been treated before being seen by the authors. They believe that radiation used alone in high dosage increases the difficulty of subsequent therapeutic procedures and renders the prognosis less favorable.

The method of treatment most often employed by the authors begins with a thorough curettage of all the abnormal tissue. This gives valuable information about the depth and extent of the lesion and allows any subsequent therapeutic measure a much greater chance of success. The area is then treated by electrocoagulation or desiccation. This treated area, plus a peripheral margin of skin, is exposed to 600 to 800 r of unfiltered roentgen rays at 105 kv., 5 ma., at a focal skin distance of 22.8 cm. This dosage is repeated every four to seven days until 2,400 to 3,000 r are given. The time required for healing ranges from four to seven weeks. Those who use the combined method as described believe that the cosmetic results are superior to those obtained by superficial radiation alone.

A total of 1,052 cases were followed for five years. Among these were 1,022 five-year cures, 15 recurrences, and 15 failures, which include 3 deaths. Of the 15 recurrences, 11 were cured by repeating the treatment or by surgical excision. Metastasis developed in only 3 cases. JOSEPH T. DANZER, M.D.

Cancer of the Maxillary Sinus Treated Solely by Deep Roentgen Irradiation. J. A. Mathez. J. de radiol. et d'électrol. **27:** 25–28, 1946.

The author recounts the details of several cases of cancer of the maxillary sinus which were given deep

x-ray therapy exclusively. The duration of life in most of them was short—a few months or a year, but death was attributed to other causes.

The attempt to establish the treatment as successful in each of these cases is hardly convincing. Even so intrepid a therapist as Pohle is skeptical of deep therapy in malignant neoplasms of the maxillary sinus, and warns that one must be willing to deliver the very maximum in dosage; among otolaryngologists the method has no standing.

In the radium clinic at Cook County Hospital, the abstractor has watched the progress of these antral cancers for several years. The oral surgeon in charge, having given a fair trial to radiotherapy, had settled on the following procedure. He removed the anterior wall of the sinus and destroyed the growth with a cautery. The sinus was left open, and the radium therapists could then implant as much radium as they deemed advisable. If the growth showed no signs of returning in about a year, the surgeon considered constructing a plastic wall and closing the sinus. No case was ever referred for deep x-ray therapy alone.

PERCY J. DELANO, M.D.

Cancer of the Larynx. Five Year Results of Concentration Radiotherapy. Max Cutler. Arch. Otolaryng. **43**:315–330, April 1946.

In a series of 118 consecutive patients with cancer of the larynx treated by irradiation at the Chicago Tumor Institute from April 1938 through December 1942, 42 per cent five-year cures and 39 per cent three-year cures were obtained. The principles and technic of the method have been previously described (J. A. M. A. **117**: 1607, Nov. 8, 1941. Abst. in Radiology **38**: 635, 1942). Concentration radiotherapy is much more intense than the divided dose technic (Coutard method) now generally used and has been successful in certain forms of laryngeal cancer hitherto regarded as incurable by irradiation. When the cords are freely movable or only partly fixed by the tumor, curability is high, but when they are completely fixed, cure is less common and laryngectomy is indicated. This report shows that patients with intrinsic squamous carcinoma of the larynx too advanced for laryngofissure and requiring total laryngectomy may be cured by irradiation. As the results of irradiation grow better, the field for surgery becomes more restricted. Laryngectomy should be limited to intrinsic lesions with complete fixation of the cords in patients who are good surgical risks and have a high life expectancy. Improvements in technic of irradiation and earlier diagnosis should further diminish the necessity of total laryngectomy.

Columnar-Celled Carcinoma of the Rectum Treated by Radon: Preliminary Report, Sixteen Months After Treatment. P. D. Braddon. M. J. Australia **1**:477, April 6, 1946.

A columnar-cell carcinoma of the rectum diagnosed eight months after excision of a rectal polyp, in a man of fifty-three years, was treated by a double-circle radon gold seed implant for a dosage of 6,700 r. The rectum was then firmly packed with vaseline gauze to prevent collapse of the treated area and to insure accurate distribution and dosage. The pack was removed after four days, an enema was given, and the rectum was repacked. This treatment was continued for fourteen days, by which time the residual gamma radiation in the seeds was negligible. At the time of the report, sixteen months following treatment, the patient was in excellent condition and had gained six pounds in weight. Except for a reaction for the first few weeks, symptoms had been conspicuous by their absence. There was no general irradiation proctitis. Locally, in the rectal wall, all that could be detected was slight scarring and tethering of the mucosa, with two seeds distinctly palpable.

Observations on the Treatment of Adenocarcinoma of the Uterus. Laman A. Gray, Milton Friedman, and William S. Randall. Surg., Gynec. & Obst. **82**: 386–404, April 1946.

The authors record 10 cases of adenocarcinoma of the uterus seen in a three-year period, prefacing their presentation with citations of the five-year survival rates obtained in various clinics in America and abroad.

An instrument called a "hysterostat," designed by one of the authors, is described. It is constructed of multiple sections, each the length of a single radium capsule, which can be screwed together in the operating room, after the contour of the uterus has been defined, so as to produce a roughly triangular distribution of radium sources within the uterine cavity. It is believed that, because of the adjustability of this device, a more even distribution of radiation can be obtained.

Intrauterine radium, in doses varying from 6,000 mg. hr. to 12,480 mg. hr., was used preoperatively in 7 patients. When the dosage was greater than 6,000 mg. hr. two applications were made. An average interval of about forty-five days elapsed between the administration of radium and panhysterectomy and bilateral salpingo-oophorectomy.

The significant finding was that in 6 of the 7 cases thus treated, small islands of viable carcinomatous cells were present in the superficial myometrium. Three patients were found, at operation, to have metastases to the ovaries, a point which the authors believe constitutes a strong argument against radiation treatment alone.

Various advantages of preoperative irradiation, including reduction of intrauterine infection, reduction in size of the uterus, immobilization of carcinomatous cells, sclerosis of lymphatics and vessels, and prevention of recurrence from operative spill, are pointed out. Disadvantages include later deleterious effects of radiation, increased hospitalization period, late recovery of vitality, diarrhea and urinary frequency.

The authors conclude that radiation alone is insufficient in the treatment of uterine adenocarcinoma and that the exact role of preoperative radiation therapy has not been satisfactorily determined.

ALTON S. HANSEN, M.D.

A Basis for Sympathectomy for Cancer of the Cervix Uteri. A. de Sousa Pereira. Arch. Surg. **52**: 260–285, March 1946.

The visceral pain of uterine and other cancers can be relieved by section of the lumbar sympathetic trunks, provided the tumor does not extend beyond the anesthetized area. However, a concurrent vasodilation is produced, and the question arises whether the increase in temperature and the better nutritive supply will not accelerate the tumor growth. The author first proves by animal experiment and observations on patients that there is actually an increased flow of blood and a tem-

perature elevation in regions subject to sympathetic section. To study the clinical results, an anesthetic block of both right and left lumbar sympathetic chains was made daily during the period of radium application, using 30 c.c. of 1 per cent procaine hydrochloride injected at the level of the 1st, 2nd, or 3rd lumbar vertebra. All patients with carcinoma of the cervix treated at the Portuguese Institute of Oncology during a year were studied, about half receiving these blocks. No special selection was made for the two groups. The technic of irradiation was that in routine use at the Portuguese Institute of Oncology: 2,400 r preceding radium application and 16,600 r following; 50 mg. of radium were used in the uterus and vagina (time not stated). Gynecologic diathermy was also given.

The results of the author's study are as follows.

Without block (34 cases)	
Improvement	47%
No improvement	20%
Recurrence	26%
Metastasis to bone	0
Death	5%
With block (28 cases)	
Improvement	60%
No improvement	7%
Recurrence	25%
Metastasis to bone	3%
Death	3%

The author concludes that, in addition to pain relief, sympathetic block in the early stages of cancer causes an improvement in the healing of the primary lesion rather than the reverse, although, as he points out, the evidence is not final because of the small number of cases.

LEWIS G. JACOBS, M.D.

Present Concepts of the Treatment of Uterine Fibroids: Position of Radiotherapy. A. Badolle. J. de radiol. et d'électrol. **27:** 19–25, 1946.

The author favors radiotherapy for uterine fibroids and sites statistics to show that their surgical treatment is rapidly on the wane. [There will be few to agree with him. The gynecologists of America discussed this question some twelve or fifteen years ago and reached the conclusion that in view of the unknown quantities present, as possible infection and possible malignancy, surgery is the treatment of choice. Other considerations in opposition to radiotherapy are the frequent presence of a secondary anemia in these patients and the possibility of sarcomatous change in a treated fibroid. Furthermore, the larger tumors, the hard ones, those with calcification, and those in the cul de sac are not amenable to irradiation.]

PERCY J. DELANO, M.D.

Open X-Ray Therapy in Carcinoma of the Bladder. D. K. Rose. J. Urol. **55:** 267–272, March 1946.

The author reports on and illustrates a type of retractor which, after suprapubic cystostomy, marsupializes the bladder wall and allows the institution of direct "open" x-ray therapy to invasive tumors of the most desperate type. This treatment may be preceded by closed x-ray therapy.

All redundant tissues and blood clots are removed from the surface of the tumor so that it receives the full benefit of irradiation. Sodium pentothal and rectal avertin anesthesia are employed to keep the patient asleep during the roentgen therapy. In addition, caudal anesthesia (15 c.c. 2 per cent novocain) is used to relax the bladder wall in order to assure optimal exposure of the tumor. A lead cuff is inserted into the bladder and surrounds the tumor, thus protecting the adjacent tissues. The skin surface is likewise protected by lead, which is cut out to fit the edge of the lead cuff circling the tumor. Drawings illustrate the various steps in the technic.

More than 40 cases have been treated. At first two doses of 1,800 r were given. There was no difficulty in exposing the tumor at a second operation. At the present time, however, 3,300 r are given in one treatment. The physical factors used in the administration of the roentgen therapy are not stated nor are the authors able as yet to furnish definite figures as to their results.

N. P. SALNER, M.D.

Vertebral Hemangioma in Children. Ira I. Kaplan. J. Pediat. **28:** 498–502, April 1946.

A case of hemangioma of the vertebrae, treated successfully by irradiation, is reported. The patient, a boy of 12 1/2 years, was admitted to the hospital, complaining of increasing numbness of the legs with weakness and loss of function of eight weeks' duration. A tentative diagnosis of a spinal new growth was made; roentgenograms suggested hemangioma. A laminectomy was performed at the level of the third to the sixth dorsal vertebrae, and a biopsy confirmed the roentgen diagnosis. Five courses of high-voltage roentgen rays (a total of 7,100 r) were given during the next twenty months. At the time of the report, approximately two years after he was first seen, the patient was free of symptoms, with good posture, and with no paralysis or retardation of bony growth.

Hematological and Clinical Characteristics of Leukemia. Russell L. Haden. Am. J. Roentgenol. **55:** 387–392, April 1946.

Leukemia is fundamentally a disturbance in leukocyte formation characterized by a disorderly multiplication of cells in the leukopoietic system and suggesting a neoplastic process. There is usually an increased number of leukocytes in the blood stream, although the number may be normal or decreased. Immature cells are almost always present. The marrow is hyperplastic and filled with immature cells even though the leukocyte count in the circulating blood may be low. In all doubtful cases study of the bone marrow by trephination or by aspiration is mandatory.

Toxemia is a characteristic finding and is manifested by fever, loss of weight, sweating, anorexia, malaise, and joint symptoms. Anemia is common, being least frequent in chronic lymphoid leukemia. The anemia is variable in type and may be macrocytic, particularly in the leukopenic patients. Thrombopenia is common, and as a result of this, hemorrhage is a frequent symptom. It may be manifested as petechiae, cerebral hemorrhage, or bleeding from the intestinal tract. Infection is a frequent occurrence in acute leukemia.

There is a wide variation in the clinical picture in different cases of leukemia, due to widespread involvement of almost all tissues of the body and to the effect of toxemia. Of 400 cases of leukemia seen at the Cleveland Clinic, the distribution was as follows: (1) acute myeloid or myeloblastic, 16.5 per cent; (2) chronic myeloid, 24.7 per cent; (3) acute lymphoid or lymphoblastic, 15.3 per cent; (4) chronic lymphoid, 29.5 per cent;

(5) acute and chronic monocytic, 14 per cent. The features characteristic of each of these types of leukemia are discussed in detail. H. H. WRIGHT, M.D.

Results of Roentgen Treatment of Leukemia. Bernard Pierre Widmann. Am. J. Roentgenol. **55:** 377–386, April 1946.

The records of 110 patients seen at the Philadelphia General Hospital with chronic myelogenous and lymphogenous leukemia were studied in an attempt to obtain statistical evaluation of the effects of various types of roentgen therapy and the influence on the life span. Of the 110 hospitalized patients, 46 were too ill to be treated. Of the remainder, 15 could not be traced following discharge from the hospital.

Of the 49 patients studied throughout their illness, 28 died and 21 were still under active treatment at the time of this report. Twelve patients lived six months or less; 17 lived three years or more; 7 lived more than five years; 2 lived thirteen years; 1 eighteen years, and 1 nineteen years after the initial treatment. The average duration of life from the time of instituting treatment was 39.7 months in the lymphogenous group and 32.3 months in the myelogenous group.

The type of treatment given and the response of different individuals to the same type of treatment were so variable that no one method of treatment was shown to be the preferred type for all cases. The general principle of therapy advocated is the use of the smallest dose compatible with establishing a state of improvement in health, well-being, and efficiency. Usually 50 r is a safe starting basis, while in refractory cases dosages up to 200 r may be necessary. The patient's general well-being, rather than the leukocyte count, is the chief criterion for the need of treatment. Favorable influence of roentgen therapy on the life span is difficult to determine statistically, but appears to be obtained in a number of cases. Improvement in general health and efficiency is achieved in more than 50 per cent of the patients treated. H. H. WRIGHT, M.D.

Epidemic Ringworm of the Scalp in Children. Ruben Nomland. J. Iowa State M. Soc. **36:** 155–157, April 1946.

The author reviews the factors entering into the present epidemic of ringworm of the scalp in the United States. The epidemic started in 1942, in New York City, and from this focus spread to the major metropolitan areas of the country and thence to the smaller cities and villages. The causative organism is *Microsporon audouini*, and the disease is almost wholly limited to children below the age of ten. Because of the age incidence, case finding is largely a matter for the school authorities. This is done by routine examination of school children and pre-school contacts by means of a Wood's light, which causes a characteristic fluorescence of the infected patches on the scalp. Confirmation of the diagnosis is obtained by direct microscopic examination of the infected hairs and by culture.

Temporary epilation by x-rays appears to be the most effective method of treatment. A dose of 350 to 400 r to five areas of the scalp will cause satisfactory epilation, and regrowth of hair will begin in six to twelve weeks. About 18 patients were treated successfully at the University of Iowa Hospitals. A typical case is recorded. Over 4,000 cases in New York City are said to have had x-ray epilation in the present epidemic without sequelae. SYDNEY F. THOMAS, M.D.

Histoplasmosis. A Report of Four Cases, Two in Siblings. Histoplasmin Test and Other Diagnostic Procedures. John H. McLeod, Chester W. Emmons, Sidney Ross, and Frederic G. Burke. J. Pediat. **28:** 275–295, March 1946.

Four cases of histoplasmosis (2 new and 2 previously reported), occurring in children living in a rural area in Virginia, within a radius of ten miles, are reported. The two new patients were brothers, constituting the first reported instance of histoplasmosis in siblings. *Histoplasma capsulatum* was isolated in culture premortem from both, although neither reacted to histoplasmin. In one of the cases a diagnostic course of roentgen irradiation to the cervical nodes was given anteriorly and posteriorly to the right side of the neck for four weeks (1,200 r). At the end of this time there was a rather remarkable reduction in the size of the nodes, although they never actually disappeared. Further roentgen therapy, totaling 3,000 r, was administered during the next five months to the various sites of nodal enlargement. The effect, however, was only palliative and did not seem to alter the course of the disease. Unsuccessful use of x-rays in other cases has been reported.

DOSAGE

Example of Need for Dermatologic Publicity of Developments in Radiologic Physics. John C. Belisario and Robert E. Pugh, Jr. Arch. Dermat. & Syph. **53:** 115–118, February 1946.

One of the authors of this paper purchased a Victoreen r meter in the United States. He visited the offices of many dermatologists in this country, checking on the dosage used in the treatment of skin lesions. He then went to Australia, where he made a study of the dosage used by dermatologists in that country. The result of this investigation was published in a paper which appeared in the *Archives of Dermatology and Syphilology* in March 1942 (Abst. in Radiology **39:** 381, 1942).

In that article it was stated that this was the first time a comparison had been made of the dosage used in the two countries, and that a unit of measurement should be established that could be used in both. This statement drew the fire of Dr. C. E. Eddy, who in a subsequent article (Arch. Dermat. Syph. **49:** 250, 1944. Abst. in Radiology **43:** 617, 1944) stated that an accurate international unit of measurement had been established. He further stated that the Australian government, with a well equipped, well staffed organization, was willing to calibrate any x-ray machine in Australia.

The purpose of the present article is to point out that the calibrating equipment was not called to the attention of the dermatologists in Australia. As no article on the subject appeared in a dermatologic journal, they did not know that this source existed [they might have been informed if dermatologic journals had abstract sections]. The authors suggest that physicists should be urged to publish articles in dermatologic magazines dealing with irradiation physics as it concerns the dermatologist.

JOSEPH T. DANZER, M.D.

Cytological Analysis of the Response of Malignant Tumours to Irradiation as an Approach to a Biological Basis for Dosage in Radiotherapy. P. C. Koller and D. W. Smithers. Brit. J. Radiol. **19:** 89–100, March 1946.

Dosage determination in irradiation depends largely on clinical observation of results. At one extreme are those therapists who from day-to-day examination of progress determine when to treat and how much to give; at the other are those who try to give as great a dose as the normal tissues can stand in the shortest possible time. What is needed is knowledge that will make it possible to determine the minimum dose that will produce an optimum effect. Scattered information is available on the effect of radiation on isolated biological material but there is little on the effect on a complicated tissue such as a cancer and its surrounding tissues. The present article is a preliminary report on the clinical variation of the response of tumors to irradiation. The study is based on 220 cases of basal-cell and squamous-cell cancer of the skin, 196 cases of cancer of the cervix, 42 of the breast, 6 of the lung, and 3 of the esophagus.

An attempt was made by cytological analysis to determine the minimum dose that would produce the optimum response in each tumor examined. One analysis was made of a pre-treatment biopsy specimen and a second at twenty-four to forty-eight hours after the initial dose of radiation, showing the alteration in rate of division, the frequency with which cells showed radiation-induced changes in the chromosomal mechanism, and the maximum amount of damage to individual cells as shown by chromosome fragments. These changes are classed as *intracellular* response.

The presence of very few or no dividing cells at the end of the twenty-four to forty-eight hour period suggests that the initial dose was probably too large for that particular tumor and that intervals of more than twenty-four hours between treatments are required. A high number of chromosome fragments is another indication that the dose was too high.

Intercellular reaction consists of inhibition of mitosis in cells adjacent to the tumor cells with resulting degeneration, infiltration by white blood cells, digestion and removal of degenerated cells, and attempts at the formation of fibrous tissue. This reaction plays an important role in treatment. Many tumors are classed as resistant, despite breakdown of the tumor cells by radiation, because of interference with the intercellular response. Timing of the treatment with relation to the intercellular response is of equal importance with choice of the correct dose. Treatment at the height of the intercellular response damages chiefly the cells responsible for the repair process. If too long a time elapses, cell death may be insufficient to maintain the intercellular response or the reparative process may advance too far.

By observation of repeated biopsies an attempt is made to regulate the dose and the rate of fractionation so that mitosis is not completely suppressed at too early a stage and the intracellular response is maintained with as small a dose as possible and the intercellular reaction interfered with as little as possible.

Studies of superficial accessible tumors indicate that fractionation with appropriate dosage and timing gives better results, with lower recurrence rates, than single large doses except in very small lesions. Repeated biposies were not possible in deep-seated tumors, but on the basis of observations on accessible tumors some cases were treated by giving increasing doses at increasing time intervals with encouraging results.

SYDNEY J. HAWLEY, M.D.

Effective Atomic Number and Energy Absorption in Tissues. F. W. Spiers. Brit. J. Radiol. **19:** 52–63, February 1946.

Measurements of the effective atomic number of excised tissues were made by an absorption method. The results of these studies were used to calculate the linear absorption coefficients and the true energy absorption of the tissues for a wide range of wave lengths. From the results thus obtained, approximations were made for conditions of actual treatment, indicating that there is a significant difference in energy absorption between fat, muscle, and bone. SYDNEY J. HAWLEY, M.D.

EFFECTS OF RADIATION

The Coagulogram as a Critical Indicator of Irradiation Effect. Preliminary Report Based Upon a Seven Year Survey of the Personnel of the Department of Radiology, Royal Victoria Hospital. Joseph Kaufmann. Am. J. Roentgenol. **55:** 464–472, April 1946.

Because examination of the cytological elements of the blood does not offer a sufficiently sensitive indication of the effects of minimal repeated doses of radiation, the author made a detailed blood study on exposed individuals, with particular emphasis on the mechanism of coagulation of the blood. In addition to complete cytological studies, the fibrin time, complete coagulation time, prothrombin concentration, and blood platelet counts were studied. Studies were made of the professional and technical personnel of the Department of Radiology (Royal Victoria Hospital), including those not exposed to any appreciable radiation. Carefully controlled, repeated examinations were made, with particular care to standardize all procedures so as to obtain maximum uniformity.

From the results obtained, it is concluded that the early effect of repeated minimal doses of roentgen or gamma radiation on the cytologic elements represents an irritative reaction manifested by mild erythrocytosis and moderate leukocytosis. Lengthening of the prothrombin time is considered to be a more critical indicator of minimal radiation damage than is study of the cytologic elements alone. Lengthening of the prothrombin time from a maximum normal of 30 seconds to 45 seconds represents a warning of possible over-exposure. If the prothrombin time is lengthened to 60 seconds or more, the individual should be temporarily removed from any exposure and an attempt should be made to neutralize the deficiency. Investigation is in progress to determine whether vitamin-K therapy may be a specific for the reduced prothrombin concentration found in connection with irradiation.

H. H. WRIGHT, M.D.

Nicotinic Acid in the Treatment of Radiation Sickness. Z. T. Lessa. Rev. paulista de med. **26:** 135–150, March 1945.

The author administered a daily dose of 25 to 50 mg. of nicotinic acid orally to prevent the development of

"radiation sickness" in 65 patients receiving roentgen therapy for different conditions. He reports that more than three-fourths of the patients did not show any general effects of radiation. In a few cases, cutaneous reactions, tenesmus, and diarrhea developed as a consequence of the administration of the drug.

A table giving the age, sex, irradiated region, dose of nicotinic acid, and the results and complications for each case observed accompanies the presentation. No details are given of the dimensions of the field of irradiation nor of the daily dose of radiation administered. This is unfortunate, since the systemic reaction known as "radiation sickness" is in definite relationship with these factors. In fact, an adequate balance of the daily dose of radiation in reference to the size of the field to be irradiated should eliminate these avoidable untoward effects of the administration of radiations. They should occur but exceptionally in the course of well planned roentgen therapy. J. A. DEL REGATO, M.D.

Medicolegal Aspects of Injuries from Exposure to Roentgen Rays and Radioactive Substances. Charles E. Dunlap. Occupational Med. **1**: 237–301, March 1946.

This is a comprehensive discussion of the medicolegal aspects of injuries from exposure to roentgen rays and radioactive substances. An extensive bibliography is appended, including numerous references to medicolegal cases involving radiation injuries